Popular Astronomy.

Vol. XXII, No. 9. NOVEMBER, 1914. Whole No. 219

DELAVAN'S COMET.

E. E. BARNARD.

Though this comet has made but little display, it is far from being a disappointment. It has really done all that was reasonably expected of it, considering its large perihelion distance. There were some astronomers, however, who had hoped for a notable display near the time of perihelion passage. But so far the comet has done little in the way of show, and it is not likely now that it will do any better.

For three months it has been visible to the naked eye, and for at least half this time it has been fairly conspicuous, though the tail has been short and not noticeable for more than three or four degrees. It could, however, for a time (about the latter part of September) be traced for a distance of ten degrees—but very feebly.

On several dates—notably on September 26—the nucleus was starlike to the naked eye and on the above date its brightness was equal to that of χ Ursa Majoris, for which magnitude 3.85 is assigned in the revised Harvard Photometry. The combined light of the head, however, has been but little less than the third magnitude.

I have already (Popular Astronomy for October 1914) called attention to the fact that the comet has two tails with an angle of some 30 degrees between them, that the light of the tail was slow in its action on the photographic plate, and that the northern tail was full of structure. These peculiarities have been marked features in all the later pictures. The northern tail is also the brighter and longer of the two on the photographs. In locating the tail among the stars with the naked eye I was struck with the fact that what was seen was not the longer and brighter north tail, as shown on the photographs, but the shorter and fainter south tail. No trace of the northern one could be seen at any time. This seemed to imply that the light of the two tails was quite different in physical nature—the north one being the bluer. Two small lantern lenses of nearly the same light ratio and aperture

are attached to the Bruce telescope. On September 29 and subsequent dates one of these was used with a yellow color filter and a Cramer Instantaneous Iso plate, while with the other an ordinary plate was used. The results seem to show that the screen cut out the north tail, but shows the south one fairly well. This would seem to indicate that the two tails are really shining with light quite distinctly different—the south one being less actinic—as was implied by the visual observations.

This quite agrees with my previous results in photographing comets —the tails that show the most structure are the quickest in photographic action. At the same time, neither of these tails is photographically quick, the northern being only relatively so.

Some of the photographs of this comet are very beautiful. This is due to the peculiarities of the two tails; one long and straight, the other diffused and strongly curved. I have not seen this combination before in the photographs of an individual comet. These features are well shown in the plate accompanying this article.

Yerkes Observatory,
Williams Bay, Wis., 1914 Oct. 19.

THE NEARNESS OF THE STARS.

BERNARD THOMAS, M.B., C.M.

There are some considerations which make it probable that the stars are not at the overwhelming distances which are so often assigned to them. No doubt the remoteness of the majority of stars is really very great and light takes some few hundreds of years to reach us from them; but, that it should be some thousands, or as often stated, millions of years on its way is not supported by any evidence worthy of the name. Probably there is a narrower limit than is often supposed to the visible sidereal system. The telescope and camera as aids to the unassisted eye have, no doubt, extended our view of space but they have done more perhaps in bringing into sight the fainter and smaller stars, not necessarily the more distant, just as the microscope enables us to see what is too minute for the naked eye.

Star Distribution. The peculiarity of star distribution has long been a subject of interest to all star-gazers. There are certain portions of the heavens which are particularly rich in bright stars and others again where stars are sparse and thinly strewn. On the whole the richest regions are found in the vicinity of the Milky Way, the barren regions

remote from it. But, aside from this general statement, there are some regions remote from the galaxy which may be considered fairly rich in naked eye stars. In the southern hemisphere I might mention the region near the northern part of Hydrus, the southern extremity of Horologium into Reticulum and Toucan; also the southern part of Dorado. Here the stars are small. The constellations Grus and Phoenix, though not of large extent, contain more than the average of bright stars. In the northern skies there is the rich patch in Coma Berenices—small stars—and the bright stars in the Great Bear and Leo. Of barren regions it is a singular fact that within a radius of twenty degrees round the south pole there are, near the border, only two stars of third magnitude, β Hydri (magnitude 2.9) and γ Hydri (magnitude 3.1).

FIGURE 1.

The constellation Indus is so barren of stars in its southern part that it has been called the Desert; a row of faint stars called the Caravan stars cross it. Herschel remarked, when speaking of the Nubecula minor, that it was singularly barren of access. In the northern hemisphere there is a space of large extent, occupied by the modern constella-

tion Camelopardus, which contains no star above the fourth magnitude.

But the strangest part of stellar distribution is the association of the brighter stars with the galaxy. The late astronomers R. A. Proctor and J. E. Gore have demonstrated by figures that all and each magnitude of naked eye stars are more numerous in the Milky Way or its immediate vicinity.

The results obtained by the Harvard Observatory have been summarized as follows:

1) The number of stars on any given area of the Milky Way is about twice as great as in an equal area of any other region.

2) This ratio does not increase for faint stars down to the 12th magnitude.

3) The Milky Way covers about one third of the sky and contains about half of the stars.

4) There are 10,000 stars down to magnitude 6.6 or brighter, 100,000 down to magnitude 8.7, one million to magnitude 11, and two million to magnitude 11.9.

"It is estimated that there are about 18 millions of stars down to the 15th magnitude visible in a telescope of 15 inches aperture."

Probably the richest portion of the heavens is the region of the Southern Cross (Fig. 1). This is rich in very bright and very small stars. Here are three first magnitude stars: α Crucis (magnitude 1.00), α Centauri (magnitude 0.06), β Centauri (magnitude 0.86). Other bright stars are β Crucis, magnitude 1.50, γ Crucis 1.60, ϵ Centauri magnitude 2.6, α Muscae 2.8, θ Argus 3.0, δ Crucis 3.1, β Muscae 3.3, q Carinae 3.4, λ Centauri 3.4, ϵ Crucis 3.6 and many others. The region is rich in double stars and clusters and contains the great nebula near η Argus, where the Milky Way is exceedingly rich in stars of 7th, 8th and 9th magnitudes, so that it seems to reach a climax of brightness.

It seems that one is almost forced to the conclusion that here the large and small stars are intimately mixed and comparatively near together. Of the stars mentioned it is of interest to note that three have parallaxes assigned to them. α Centauri is of course our nearest neighbor, with a parallax of $0''.759$ (4.29 light years), and no doubt is not a part of the galaxy cluster. Two others, α Crucis and β Centauri (both of B1 or Orion type), have a small parallax of $0''.05$ assigned by Gill. This is a distance of 65 light years and of course such a small parallax is very uncertain. On the other hand β Crucis, the same type star, was found to be at an immeasurable distance. Whether this was really due to the great distance of that star, or to the fact that the comparison stars were really at the same distance as the primary, it is impossible to say. But I note that the proper motion of β Crucis is nearly the same as that of the brighter star α and almost in the same

direction (p.m. 0″.05).

Near α Crucis is the wonderful coal-sack, where we apparently see right through the galaxy into the darkness beyond. Some faint telescopic stars may be seen and oddly enough a tiny cluster of stars of about 10th magnitude lies near the only lucid star (40 Crucis, the Oasis star, about 6th magnitude) in this region. This is N.G.C. 4609.

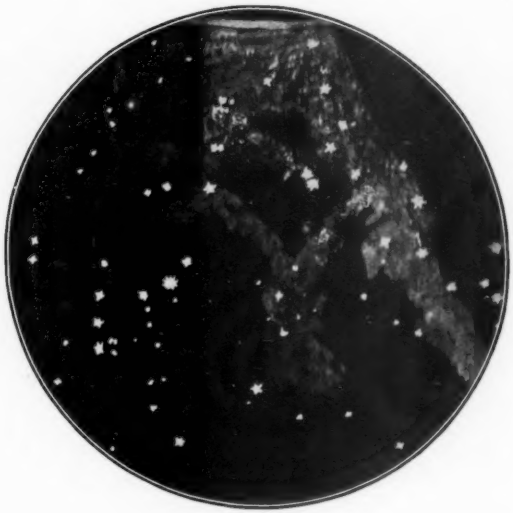


FIGURE 2.

The convolutions of the Milky Way near the tail of the Scorpion, the numerous clusters embedded in it and the bright stars 'projected' on it, form a sight which is noteworthy to southern observers (Fig. 2). Here the stars seem to follow faithfully the outline of the galaxy. Clusters too seem associated with bright stars and the Milky Way.

I note that the stars in the head of Scorpio form a well marked stream (Fig. 3) in which the terminal portion does not seem to participate. All these stars with the exception of Antares and ω^2 are white or Type I stars.

From these considerations it seems probable to the writer that many, but not all, of these bright stars are really imbedded in the galaxy.

The following table, which I have taken from the interesting article on "The Spectra and other characteristics of the Stars" by H. N. Russell in POPULAR ASTRONOMY for May, has a bearing on the point.

The table is from counts made at Harvard.

TABLE I.

Spectrum	O	B	A	F	G	K	M	N	Total
Number above 3¼ mag.	3	52	32	16	20	35	21	0	179
" " 6¼ mag.	20	696	1885	720	609	1719	457	8	6114
Percentage of Galactic stars	100	82	66	57	58	56	54	87*	67.57**

The last column is added by myself.

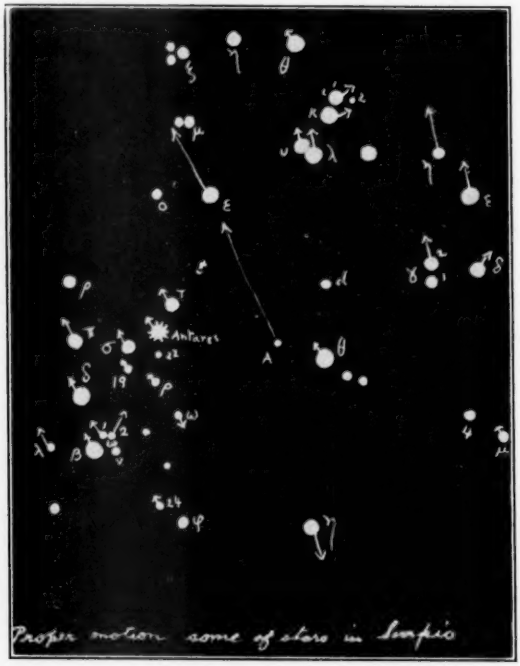


FIGURE 3.

Thus it seems clear that stars of all types are more numerous in this vast cluster—or cluster of clusters—the galaxy, but the white stars (Wolf-Rayet, Helium, Hydrogen) and the true red stars (Carbon, class N) are much more numerous here than in the other parts of the sky.

I note that Professor Perrine of the Lick Observatory finds that "stars fainter than the 15th magnitude predominate in the Milky Way

* Derived from fainter than 6¼.

** Not including N stars.

and globular clusters but elsewhere are relatively scarce." This would seem to suggest that for the most part these stars are faint owing to smallness or lack of luminosity and not owing to distance. It does not seem probable that they are really comparable to our sun at a distance of 3,260 light years (sun's stellar magnitude −26.5).

TABLE II.

PARALLAXES OF THE NEARER STARS.

	Star	Magnitude	Type	Parallax	Light years	Proper motion	Luminosity
1	α Centauri	0.31 1.70	G K	0".76	4.3	3".69	1.26 0.36
2	Lal. 21185 Ursae Maj.	7.60	Ma	0.40	8.1	4.78	0.006
3	Sirius	−1.58 8.44	A	0.38	8.7	1.32	30.1 0.003
4	Po. 130 Sculptoris (82 Sculpt.)	6.37 6.57	K K	0.36	9.1	1.38	0.022 0.018
5	ε Eridani	9.0 3.81	 K	0.33	9.9	0.97	0.002 0.018
6	Procyon	0.48 10.0	F5	0 32	10.2	1.22	6.13 0.01
7	C. Z. V^{h} 243 (Pictoris)	8.3		0.32	10.2	8.70	0.005
8	τ Ceti	3.65	K	0.31	10.4	1.94	0.36
9	*61 Cygni	5.57 6.28	K5 K5	0.31	10.4	5.25 5.15	0.061 0.032
10	Lac. 9352(Pisces Aust.)	7.44	Ma	0.29	11.2	7.02	0.012
11	Σ 2398 (Draconis)	9.13 9.91	K	0.29	11.2	2.28	0.0024 0.0013
12	ε Indi	4.74	K5	0.28	11.5	4.67	0.17
13	Groom. 34 (Androm.)	7.73 11.	Ma	0.28	11.5	2.85	0.01
14	OAN. 17415 (Draconis)	9.3	F	0.27	12.1	1.31	0.0026
15	Lal. 2534 (Bootis)	6.29 6.29	A	0.26	12.5	0.11	0.045 0.045
16	Krueger 60 (Cephei)	9.43	K3	0.26	12.5	0.92	0.0026
17	97 Monocerotis	5.33	A	0.26	12.5	0.20	0.07

* Russell finds parallax of 5.57 = 0".41 (9.5 light years) and 6.28 = 0".36 (10.1).

This is a list of 17 stars accredited with a parallax of 0″.26 or over (12.5 light years). No doubt others might be added, as 36 Ophiuchi (parallax 0″.30) and others, but all in this list are fairly well authenticated. Only three are first magnitude stars and six are invisible to the naked eye. Only three have a greater luminosity than the sun and the rest very much less than our luminary. All types of spectrum are represented except B, O and N.

Of type B stars the nearest seem to be α Crucis, β Centauri and Achernar if we can trust the very small parallxes found for them.

TABLE III.

PARALLAXES OF FIRST MAGNITUDE STARS.

Star	Magnitude	Type	Parallax	Light years	Proper Motion
α Centauri	0.06	G and K	0″.759	4.29	3″.69
Sirius	—1.58	A	0.376	8.67	1.32
Procyon	0.48	F5	0.334	10.6	1.22
Altair	0.89	A5	0.232	14.2	0.60
Fomalhaut	1.29	A3	0.13	25.0	0.30
Aldebaran	1.06	K5	0.116[1]	28.9	0.19
Vega	0.14	A	0.082[2]	43.5	0.36
Capella	0.21	G	0.079	45.2	0.43
Arcturus	0.24	K	0.066	54.0	2.30
Pollux	1.21	G	0.06	59.4	0.50
α Crucis	1.03	B1andB1	0.05	65.3	0.05
β Centauri	0.86	B1	0.05	65.3	0.04
Achernar	0.60	B5	0.043	73.4	0.07
Betelgeuse	0.92 (Var)	Ma	0.03	108.6	0.03
Antares	1.22	Map	0.03	108.6	0.03
Castor	1.58	A0	0.028[3]	116.3	0.17
Regulus	1.34	A	0.022	148.3	0.27
Rigel	0.34	B			0.001
β Crucis	1.50	B1	[4]		0.05
Spica	1.21	B2	0.008?	407.2	0.02
Arided	1.33	A2			0.004
Canopus	—0.86	F			0.01

([1]) Parallax of 0″.107 also given, = 30.5 light years. ([2]) Parallax of 0″.10 found by Flint, = 32.6 light years. ([3]) Flint 1912, parallax of 0″.174 = 19 light years. ([4]) Really no parallax, as error is very large.

Most of the bright stars are thus very distant. As a matter of fact however I do not think we can trust at all any parallax less than 0″.05, a distance of 65 light years, and strictly speaking no parallax below 0″.1 can be regarded as anything but the merest approximation, and all below 0″.30 as probably only a rough approximation to the truth; this from the nature of the problem, the difficulty of measuring such minute quantities, and not from the care and skill of observers.

What we do know fairly accurately of those stars in our immediate vicinity is that the small or less luminous stars are four or five times more numerous than the sun-like stars, and it seems probable that this proportion may exist in the rest of the heavens. In the clusters and Milky Way the small stars may and probably do many times out number the larger.

THE MASSES OF BINARIES. It has been found that those binaries with fairly large parallaxes and whose orbits are fairly well authenticated compare in point of mass with the sun. This is well brought out in a paper in POPULAR ASTRONOMY for May 11, 1911 by Percival Lowell on "The Sun as a Star". It is shown that very large masses are found for those binaries with small and uncertain parallaxes. "Parallaxes beyond 0″.067 are too small to be trustworthy." "The masses of those stars for which alone we have dependable data are, in the mean, almost exactly the same as the sun."* It would be reasonable to infer that the small parallaxes are too small when the masses are too great.

TABLE IV.

SOME OF THE NEARER VISUAL BINARIES.

Binary	Magnitudes	Period Years	Parallax	Sum of Masses, Sun = 1
82 Ceti	6.4, 6.6	24.0	0″.360	0.01
μ Cassiop.	4.0, 7.5	345.6	0.201	1.06
40^2 Eridani	9.1, 10.8	180.0	0.174	0.64
Sirius	—1.6, 8.4	49.3	0.376	3.33
Procyon	0.5, 10	40.0	0.324	3.57
ξ Ursae Maj.	4.0, 4.9	60.0	0.179	0.76
α Centauri	0.3, 1.7	81.1	0.759	1.93
μ^1 Herculis	10.5, 11.0	45.0	0.106	1.11
70 Ophiuchi	4.1, 6.1	88.4	0.168	2.54

It may be mentioned that the components of Sirius are respectively nearly two and a half and a little greater than the sun in mass; Procyon nearly two and three quarters and a little less than the sun; those of α Centauri, one a little greater the other a little less than the sun. Of spectroscopic binaries we have Capella one and a quarter times and equal to the sun. Spica is stated to be by some authorities ten and six times greater than the sun, by others a little more than two and a half times, combined mass. So that here we have some uncertainty.

Mass does not seem to vary as much as luminosity. Thus Sirius is quite thirty times as luminous as our sun but barely two and a half times the mass, while its companion, with mass somewhat greater than our sun, is about one-three hundredth times as luminous. Capella,

* POPULAR ASTRONOMY, Vol. XIX, page 287.

although only a little heavier than our luminary, is 128 times as brilliant, although a star of apparently the same type (G). Its close companion is however of the Sirian type (A). This is rather peculiar and might be explained by a too small parallax.

There certainly seem however to be some stars of large mass, just as there are many which are more luminous than our sun. Luminosity depends in part on spectrum, those stars of B and A type being more and those of K and M being less brilliant than our sun.

PARALLAXES HOW OBTAINED. The best parallax results are obtained by measuring the shift (or apparent shift) in six months between the star required and one or more comparison stars which are assumed to be at a much greater distance. This gives double the horizontal parallax. The measurement is made by micrometer, heliometer or photography. What is obtained is really the difference of parallax of the two stars. It is a relative parallax, smaller than it should be by the true parallax of the comparison star—whatever that may be. Thus suppose there are two stars, one with an absolute parallax of 0″.05, the other of 0″.01, then the relative parallax will be 0″.04 and we must add 0″.01, making 0″.05 to get the real distance of the star. If the comparison star had the same parallax and was at the same distance the result would be 0″.00 and if nearer—as sometimes happens—a negative result would be obtained. The problem is thus very difficult apart from the likely errors arising from the mechanical difficulty of measuring so small an amount. The reason why so many bright stars have yielded such very small parallaxes is possibly that the stars in the field are at about the same distance from us.

PROPER MOTION. One thing is certain; the brighter stars are not nearer to us than many of the fainter. Magnitude tells us little about the distance of the stars. Stars with large proper motion are on the average nearer to us than those with small. But still some of the stars with very large proper motions are farther off than we should expect; for instance Arcturus (see Table III). The well known star 1830 Groombridge in Ursa Major, magnitude 6.6, with the large p.m. of 7″.05 per annum, has according to Newcomb a parallax of only 0″.14, or a distance of a little over 23 light years, and I believe later results place it somewhat farther off. From the list of some of the nearer stars (Table I) it will be seen that some of the proper motions are not excessive.

It seems evident from recent researches, notably of Campbell, Boss and others, that the motion of the stars is in some way related to spectral type. It must also be observed that proper motion is only motion across the line of sight and that all stars have radial motion towards or from us, as found by the spectroscope, and it is a correct

combination of these that gives us the star's true motion in space with respect to us. Even our own sun is moving with the speed of twelve miles (or 19.4 kms) per second, approximately towards the bright star Vega.

TABLE V.

CROSS MOTION AND RADIAL VELOCITIES AS FUNCTIONS OF SPECTRAL TYPE.

Type	Mean Cross Motion		Mean Radial motion	
	Kilometres per second	Miles per second	Kilometres per second	Miles per second
B	6.3	4.0	6.2	3.9
A	10.2	6.3	10.5	6.5
F	16.2	10.1	14.4	8.9
G	18.6	11.6	15.9	9.9
K	15.1	9.4	16.8	10.3
M	17.1	10.5	17.1	10.5

Thus the B stars move slowest, the solar stars fastest; the A or Sirian stars a little faster than the Orion stars. It is noteworthy that the Class I (B and A) stars, found particularly in galactic regions, are the slowest and have very small proper motions.

MAGNITUDE AND DISTANCE. It is interesting to consider what would be the sun's distance, if it were so far removed as to appear as a star. Taking the sun's stellar magnitude as − 26.5, to equal a first magnitude star like Altair, Aldebaran or α Crucis, it would have to be removed 3¼ light years; as a fifth magnitude star, 32½ light years; as a tenth 326, as a fifteenth 3,200 and as a twentieth magnitude 32,000 light years—an enormous distance. Possibly no visible star is so remote as this.

Bearing on this is the generally accepted fact that, although the stars increase for each magnitude in a certain definite ratio (about three times), when we get to stars fainter than the tenth magnitude the ratio breaks down and diminishes and this seems to point to a limit of the visible universe. If the sun is an average sized star—and there are some grounds for thinking it is above and not below the average—we can then well believe that about 300 or 500 light years is the limit of our sidereal system, which includes all the visible stars, star clusters, nebulae and galaxy.

DISTANT COMPANIONS AND DOUBLE STARS.

Certain problems seem hard to explain if we accept the great distance of the stars. For instance there are many cases of distant companions to bright stars and some double stars which, from their common proper motion, are associated, probably forming binaries of very long period.

Regulus, magnitude 1.3, has an 8.4 *comes* at 306°.6; 176″.9. Same p.m. of 0″.267. If the parallax of Regulus is so small as 0.″022, distance apart is at least 8000 units (sun's distance from earth = 1).

Aldebaran has a *comes* at 109°.0; 31″.4. Common proper motion 0″.19 (270 units).

Castor, the well known binary (and double spectroscopic binary) has 9.5 magnitude *comes* at 162°.5; 72″.5; c.p.m. 0″.17 (2000 units).

36 *Ophiuchi* a binary of large proper motion 1″.27, which is shared with a 6½ magnitude (30 Scorpii) at 13′ distance, angle 70°. The parallax of this star is large, 0″.305 (2754 units).

o^2 *Eridani*, magnitude 4½, has 9.1 *comes* at 107°.5; 85″.3. Both have very large proper motion of 4″.05. A parallax of 0″.174 has been found (about 490 units).

κ *Toucani*, itself a binary, is separated from the binary LL9752 at distance 308″ and angle 315°. Innes remarks same proper motion 0″.41 and perhaps period of 300,000 years.

Capella has recently been found to have a 10.6 magnitude at 12′ 3.3″ (723″.3), angle 141°.3. Same p.m. of 0″.43 (about 900 units).

μ^2 *Herculis*. The bright star, magnitude 3.48, has 8 magnitude (μ^1 a binary) at 241°.3; 29″.9. Same proper motion of nearly a second. Parallax of 0″.106 or distance of 30.7 light years (about 280 units).

μ *Bootes*, wide pair, 4 and 6.5 magnitude, angle 171°.9, distance 108″.5. Common proper motion.

Cor Carolii, magnitudes 3.2 and 5.7; 227°.3; 19″.9. Common proper motion of 0″.18.

37 *Ceti*, magnitudes 5.0 and 7.0; 331°.4; 50″.1. Common proper motion about 0″.3.

83 *Leonis*, magnitudes 6.3 and 7.3, angle 150°; distance 29″.6. Common proper motion 0″.73.

γ *Leporis*, 4 and 6½ magnitudes, angle 349° and distance 92″.9. Large common proper motion, about ½″.

Many others might be mentioned.

Conclusion. The considerations above mentioned afford grounds for a belief that the Universe of visible stars is smaller and more contracted than so often stated. Until we have more evidence to the contrary, we can assume that the extreme distance of the stars and nebulae is not more, and probably less, than five hundred light years. That the less luminous stars far outnumber the brighter ones and are not at greater distance. That the sun is a star of more than average size and luminosity, although there are some which are giants in size and others with a brighter intrinsic surface. That the galaxy is within this belt, a cluster of clusters of small suns with slow motions and with larger suns amongst them.

Note. Since writing the above I note an article in *Knowledge* "On Stellar and Nebular Distances" by Professor Frank W. Very. The author arrives at much the same conclusions, although on somewhat different lines.*

Glenorchy, Tasmania.
July 22, 1914.

* *Knowledge* September and October 1912, Vol. XXXV, pages 328, 373.

THE ZODIAC.

CHARLES NEVERS HOLMES.

Some part of the zodiac we have always with us, although unfortunately we cannot see that part against whose starry background the sun is brilliantly shining. The popular interest is with the zodiac of night, not that of day, and, accordingly, most of us do not exactly know where the so-called line of our sun's ecliptic crosses each one of these twelve constellations. In fact, most of the citizens of our highly civilized republic do not bother about the ecliptic, only remembering that they studied respecting such a subject when at school. Nevertheless, the line of the ecliptic does stand for something, being a sky-road exactly in the middle of the better-known zodiac. As is very familiar to everyone, the zodiac is a star-lit belt—some 16 degrees in width—that extends like a huge circle wholly around the firmament. It is the royal highway of King Sol, although he takes good care to keep exactly in the very middle of this royal highway, on the line of the ecliptic, having eight degrees of space to the right of him and eight degrees of space to the left of him.

If it were not for our silvery moon and the larger planets, the zodiac would never be heard of, and the imaginary line of the ecliptic would suffice for the firmamental highway of King Sol. But some of the old time people—unassisted by telescopes—were excellent observers. Way back in those days, these ancient people discerned that the moon and the larger planets always took an approximate course across the firmament. They also discerned that neither our own satellite nor the large solar satellites ever went very far away from the sky-pathway of our sun. In fact, they must have estimated somewhat accurately that the moon and the planets never strayed over a border line eight degrees from the ecliptic or path of the sun.

Meanwhile, the configurations of certain groups of sparkling suns had been observed and named by these ancient people. It was only natural that they should particularly note those constellations which were crossed by the moon and the larger planets. Of course, the earliest astronomical ideas of these observant people were very crude, and our present zodiac was probably of slow growth. Its invention or rather the invention of part of it has been credited to several of the older races, the Egyptians among these. Indeed, Dupuis was strongly

of this opinion, asserting that the constellations referred to the division of the seasons and to the agriculture that existed at the time of their invention. Dupuis believed that the constellation Cancer was representative of the retrogradation of the sun at the solstice, and that Libra represented the equality of day and night at the equinoxes. His belief was supported by several coincidences, as the inundation of the river Nile, occurring after the summer solstice, happens when the sun is reigning in Aquarius and Pisces. Nevertheless, there was at least one very serious objection to this theory held by Dupuis, although in a form his idea was adopted by Laplace and other astronomers.

But the invention of the firmamental zodiac has also been claimed for the races in Babylonia, around the year 2000 B. C., and the passage in the first book of Moses, commonly called Genesis—"And God said, let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days and years"—has been quoted to show that the Jews were early acquainted with the zodiac. However this may be, it seems very probable that our present zodiac in a crude, incomplete form was invented by ancient Euphratean astronomers, perhaps with only six of the twelve constellations of today. These early six constellations were possibly Taurus, Cancer, Virgo, Scorpio, Capricornus and Pisces, being, as is evident, alternate constellations. But these six constellation signs would in time have to be divided, owing to the passage yearly of twelve full moons through successive portions of the zodiac. Nevertheless, Servius, around 400 A. D., declared that for a long time the zodiac contained but eleven constellations, Scorpio and his claws representing a double sign. Be this as it may, the zodiac was adopted by the Greeks around the sixth Century, B.C., and it was introduced by them into the western countries. In fact, Seneca went so far as to assert that the Greeks invented the zodiac, about the year 1400 or 1500 B.C.

The name zodiac is believed to have originated from *Ζώον*, meaning a living creature, for the reason that all the constellations in it represent, with the exception of Libra, some kind of animal. As the zodiac is today, it is an imaginary belt some 16 degrees in width, divided into twelve equal sections or signs, 30 degrees in length. Every one of these twelve sections belongs to a certain constellation, and the sun reigns successively, month by month, enthroned against the background of one after another of these constellations or sections. Every one of these twelve zodiacal sections has a symbol, and these twelve symbols are, as a rule, rather crude imaginary representations of the constellations. These zodiacal symbols first came into use about the tenth Century, A. D. Some of these symbols are not wholly clear in their

origin and their meaning. Of course, the sign for the constellation Aquarius, consisting of two parallel uneven lines, represents the Egyptian character for water. On the other hand, the symbols for Leo, Virgo and Capricornus have been somewhat in doubt, although it has been suggested that the sign for Leo is merely a "cursive" form for the initial letter of Λέων.

As has been stated, the zodiac is divided into twelve equal sections, of 30 degrees each. It is interesting respecting these divisions, to quote here a paragraph which explains how the ancient astronomers portioned off the firmament into twelve equal divisions. "They took a vessel with a small hole in the bottom, and allowed water to drop slowly through it into another placed beneath, from the time one star rose until its rising on the following night. The water thus caught was then divided equally into twelve parts, and poured once more into the strainer. As each twelfth part finished dropping through, they observed what star was rising in the quarter of the heavens where lay the sun's path, and gave it and its constellation a name, generally that of some animal."

There are, of course, many references to the zodiac in ancient and modern literature. Riccioli cites a Chaldean title—"Hadronitho Demalusche" or "Circle of the Signs." In Arabia, the zodiac was known as "The Girdle of the Signs." In Greece, it was called the "Twelve Parts," and in Rome "Zodiacus." In early English literature it was mentioned, and the Englishmen of five centuries ago spoke of it as "The Bestiary", "Our Ladye's Waye", and also, as "The Girdle of the Sky."

When, thousands of years ago, the zodiac was invented and its constellation divisions named, the sun occupied a somewhat different situation along the ecliptic than he does today. Since that time, owing to the well-known precession of the equinoxes, our sun has apparently shifted his former position, so that he is no longer on a certain month reigning against the background of the same constellation where he did some thousands of years ago. In other words, the signs have moved back westward almost a whole section on the zodiac, and where the constellation Aries was formerly in the starry firmament, the constellation of Pisces sparkles tonight. Thus, some confusion has arisen in the popular mind respecting the sun, the signs, and the constellations. In some of our Almanacs, we shall find that Aries, the Ram, still presides over the month of March, and it is true that the sign of Aries is yet associated with that month. That is the sun, on the 21st of March, is mentioned in connection with the sign of Aries; but upon that date he really enters the constellation of Pisces—a constellation that is now where Aries used to be. Centuries ago, our sun entered Aries and shone for a month against its invisible background; but in this 20th

century, owing to a change in the relative position of our earth, he appears to enter the constellation of Pisces—a constellation to the westward of Aries.

As we all know, on March 21st—called the vernal equinox—the center of the sun seems to be exactly at one of the points where the line of the ecliptic crosses the line of the equator. This point is also called the "first point of Aries", and, from this moment, the sun begins to climb above the equator towards his highest northern position—the summer solstice. From this moment spring begins, and our sun has also commenced or recommenced his journey around the zodiac. For one month he crosses Pisces; the next month (April) he crosses Aries; and the next month (May) he crosses Taurus. The spring is over. Summer comes when the sun begins to enter the constellation Gemini (June). He crosses Cancer in July, and Leo in August. Summer is over, and autumn commences as the sun enters the constellation of Virgo. He crosses Virgo in September, passes through Libra in October, and leaves Scorpio in December. Fall is past, and our sun during the winter months crosses respectively the constellations of Sagittarius (December), Capricornus (January), and Aquarius (February). Winter has gone; and King Sol has made his annual circle of the zodiac.

Boston, Mass.
Hotel Nottingham.

KING JUPITER.

In golden glory over roof and spire,
Like tiny moon that shines serene and bright,
Yon planet-king reflects Sol's saffron fire—
A mighty mirror on the walls of night;
In sun-lit splendor slowly rising higher
When gloaming goes and Venus sets so white,
More glorious than Vega and her Lyre,
King Jupiter is regnant in men's sight.

CHARLES NEVERS HOLMES.

PLATE XXVI

MEMBERS AND VISITORS AT THE SEVENTEENTH MEETING OF THE AMERICAN ASTROMICAL SOCIETY AT EVANSTON, ILLINOIS, AUGUST 25-28, 1914.

KEY TO PLATE XXVI.

1	Johnson, G. F.	15	Russell	29	Maxwell	43	Jordan
2	Kiess	16	Mrs. Jordan	30	Miss Jenkins	44	Stetson
3	Morehouse	17	Leonard	31	Parkhurst	45	Alden
4	Vrooman	18	Mrs. Frisby	32	Comstock	46	Eichelberger
5	Plaskett	19	Miss Bigelow	33	Miss Cannon	47	Cogshall
6	Beal, W. O.	20	Miller	34	Baker	48	Willson, R. W.
7	Fox	21	Frost	35	Miss Lewis	49	Mrs. Duncan
8	Merrill	22	Schlesinger	36	Fischer	50	Duncan
9	Roe	23	Miss Whiting	37	Mrs. Leavenworth	52	Smith
10	Flint	24	Mrs. Parkhurst	38	Beal, A. F.	53	Fath
11	Shedd, J. C.	25	Stebbins	39	Mrs. Stetson	54	Poor, J. M.
12	Slipher, V. M.	26	Pickernig	40	Wilson, D. T.	55	Hubble
13	Mellish	27	Curtiss, R. H.	41	Apple	56	Jewell
14	Frisby	28	Miss Young	42	Leavenworth	57	Lee

AMERICAN ASTRONOMICAL SOCIETY.

REPORT OF THE SEVENTEENTH MEETING.

The seventeenth annual meeting of the Society was held at Northwestern University in Evanston, Illinois, from August 25 to 28, 1914. The members were housed in the residential quadrangles on the north campus, in the open dormitories and in the fraternity houses. The two fraternities, ΔΥ and ΔΤΔ, opened their dining rooms and served meals during the days of the meetings.

Six meetings were held for the transaction of business and presentation of papers. These were held in the lecture room of the Swift Hall of Engineering. The first meeting was called to order by the President, Professor E. C. Pickering, who introduced Professor Thomas F. Holgate, Dean of the College of Liberal Arts of Northwestern University, who welcomed the Society to Evanston and to the University. Professor Elias Colbert, President of the Chicago Astronomical Society, greeted the Society in the name of that organization and welcomed the members to the institution which the Chicago Astronomical Society founded and fosters, the Dearborn Observatory. To these introductory addresses the President replied and immediately thereafter opened the scientific program.

Forty-eight papers were read at the regular sessions. At the conversazione on the evening of August 26, photographs, lantern-slides, diagrams, apparatus illustrating astronomical work and teaching were shown. The following members participated in that program: V. M. Slipher, lantern-slides of spectra of the nebulae; E. C. Pickering, prints of star fields, clusters, spectra, etc.; J. S. Plaskett, diagrams of the mounting of the new 72-inch reflector; Miss Sarah F. Whiting, photographs of the gifts by Lady Huggins to the Whitin Observatory; Miss Annie J. Cannon, report of the work of classification of the stars, and slides from photographs taken at the Bonn and Hamburg meetings of

last summer; H. A. Fischer, illustrations from lectures on the history of astronomy; R. W. Willson, exhibition of astronomical laboratory apparatus; A. S. Flint, results with a Gaertner printing chronograph; J. A. Miller, stellar parallax results; Joel Stebbins, slides showing a reflector of short focal-length; John F. Hayford, description of work on the Costa Rica-Panama boundary survey and exhibition of maps.

The petition for the amendment to the Constitution of which the Society had been notified, in compliance with Art. VI, was submitted for consideration on August 26. The proposed amendment to the Constitution read:

"Art. I Sec. 1. This association shall be called the American Astronomical Society."

replacing

"Art. I Sec. 1. This association shall be called the Astronomical and Astrophysical Society of America."

After some discussion action was deferred until the morning session of August 27. The vote then taken was unanimously in the affirmative and the name of the association is now the

American Astronomical Society.

With reference to the proposed observatory at the University of Arizona a resolution was adopted as follows:

"Whereas, An effort is being made to secure a legislative appropriation in the State of Arizona for installing at the University thereof a telescope of large size with suitable appurtenances,

"Therefore be it resolved, That the American Astronomical Society regards with much interest the proposition to create a new observatory under what it believes to be unusually favorable astronomical conditions and expresses hereby its best wishes for the successful completion of the undertaking."

In the interest of the International Geodetic Association a resolution was adopted urging the restoration of the congressional grant for the maintenance of the Association.

As a number of observatories are entering or about to enter on a program of observations for the determination of stellar parallax, a committee was appointed in the hope that it might serve a purpose in furthering the work. The personnel of the committee is Messrs. Adams, Comstock, Fox, Frost, Miller, Mitchell, and Schlesinger. The committee is to perfect its own organization and may add to its membership.*

* Professor Frederick Slocum has been added to the committee.

The Council elected the following candidates to membership in the Society.

Charles Edward Adams, Hector Observatory, Wellington, New Zealand.
Harold Lee Alden, Yerkes Observatory, Williams Bay, Wis.
Cora Gertrude Burwell, Mt. Wilson Solar Observatory, Pasadena, Cal.
Francis E. Carr, Oberlin College, Oberlin, Ohio.
Fannie R. Gaston, 3441 Observatory Place, Cincinnati, Ohio.
Edwin P. Hubble, Yerkes Observatory, Williams Bay, Wis.
S. C. Hunter, Premium Point Park, New Rochelle, N. Y.
Louise F. Jenkins, Allegheny Observatory, Pittsburgh, Pa.
George F. Johnson, Illinois Watch Co., Springfield, Ill.
Jacob Kunz, University of Illinois, Urbana, Ill.
Arthur M. Lewis, 120 W. Oak St., Chicago, Ill.
Charles Albert Maney, Yerkes Observatory, Williams Bay, Wis.
Malcolm McNeill, Lake Forest University, Lake Forest, Ill.
E. J. Moulton, Northwestern University, Evanston, Ill.
S. B. Nicholson, 2226 Chapel St., Berkeley, Cal.
William Tyler Olcott, 62 Church St., Norwich, Conn.
Francis G. Pease, Mt. Wilson Solar Observatory, Pasadena, Cal.
John H. Pitman, Swarthmore College, Swarthmore, Pa.
H. H. Plaskett, Dominion Observatory, Ottawa, Can.
Richard E. Schmidt, 104 S. Michigan Ave., Chicago, Ill.
Jessie May Short, Yerkes Observatory, Williams Bay, Wis.
Hannah Bard Steele, Sproul Observatory, Swarthmore, Pa.
A. van Maanen, Mt. Wilson Solar Observatory, Pasadena, Cal.
H. W. Vrooman, Kokomo, Ind.
Chester B. Watts, U. S. Naval Observatory, Washington, D. C.
Samuel J. Wifvat, Drake University, Des Moines, Ia.
Latimer J. Wilson, 1405 Gartland Ave., Nashville, Tenn.

and upon presentation of a petition in due form

Oskar Backlund, Observatoire Central Nicholas, Pulkova, Russia,

was unanimously elected to Honorary Membership.

On August 27 officers were elected as follows:

President	E. C. Pickering
First Vice-President	G. C. Comstock
Second Vice-President	Frank Schlesinger
Treasurer	Annie J. Cannon
Councillors for 1914-1916	W. S. Eichelberger
	J. S. Plaskett

Officers who continue to serve unexpired terms are:

Secretary	Philip Fox
Councillors for 1913-1915	E. B. Frost
	W. W. Campbell

On Tuesday evening an informal reception was tendered to the Society and local guests by the local members of the Society in the home of Mr. and Mrs. Philip Fox, and in the Dearborn Observatory,

near at hand. The Observatory was open for inspection and at the telescope were shown the field of the Polar Sequence, M 13, Jupiter, Uranus and its moons, and certain double stars. On Thursday afternoon and evening, as a further relaxation from the scientific program, the members of the Society were the guests of Northwestern University on an excursion to Ravinia Park for the afternoon and evening concerts and for dinner. The trip was made on a special car travelling on the Milwaukee Electric Railroad. In the afternoon the Thomas Orchestra under Josef Pasternack presented a fine program. After the concert a walk was taken to the bluff over the lake. The atmosphere was clear, affording a wide view, and the lake, tossing under a northeast breeze, was very beautiful. In the evening two extracts from the operas were given, the Garden Scene from "The Jewels of the Madonna," and the Nile Scene from "Aida".

The account of this gathering would not be complete without mention of the very informal but very enjoyable meetings of those members who did not shrink from, or rather, shun, the waters of Lake Michigan.

The 1915 meeting will be held in San Francisco, Berkeley, and at the Lick Observatory, probably in conjunction with the American Association, during the first week of August. It was voted by the Council that this meeting should be the annual meeting for 1915. In this connection it should be mentioned that Professor W. H. Pickering urges those members who propose to make the trip by water and through the canal, to plan to stop at Mandeville, Jamaica, W. I., and to visit there the observatory under his direction.

The following members of the society were in attendance:

H. L. Alden
A. T. G. Apple
R. H. Baker
E. E. Barnard
S. B. Barrett
W. O. Beal
Harriett W. Bigelow
Annie J. Cannon
W. A. Cogshall
G. C. Comstock
Henry Crew
R. H. Curtiss
J. C. Duncan
W. S. Eichelberger
E. A. Fath
H. A. Fischer
A. S. Flint
Philip Fox
Edgar Frisby
E. B. Frost
Wm. Gaertner
Henry Gale
C. H. Gingrich
J. F. Hayford
T. F. Holgate
L. A. Hopkins
E. P. Hubble
Louise F. Jenkins
L. E. Jewell
G. F. Johnson
F. C. Jordan
C. C. Kiess
Jacob Kunz
Kurt Laves
F. P. Leavenworth
O. J. Lee
A. M. Lewis
J. E. Mellish
P. W. Merrill
J. A. Miller
D. W. Morehouse
E. J. Moulton
F. R. Moulton
J. A. Parkhurst
O. L. Petitdidier
E. C. Pickering
H. H. Plaskett
J. S. Plaskett
J. M. Poor
E. D. Roe
H. N. Russell
Frank Schlesinger
R. E. Schmidt
J. C. Shedd
Jessie M. Short
V. M. Slipher
Elliott Smith
Joel Stebbins
H. T. Stetson
F. D. Urie
H. W. Vrooman
Sarah F. Whiting
S. J. Wifvat
R. W. Willson
D. T. Wilson
Anne S. Young

In point of attendance and also in the number of papers this meeting is the largest since the organization of the Society; and it is second only to the Yerkes Observatory meeting of 1909 in the number of new members admitted.

At the final meeting this resolution was presented and adopted:

"Resolved that the American Astronomical Society tenders its cordial thanks to the Northwestern University for the use of its buildings during the meetings of the Society at Evanston and to the Trustees of the University, to the local members of the Society and to the Delta Upsilon and Delta Tau Delta fraternities for all the courtesies and hospitality extended to the Society."

On Friday afternoon after the adjournment many members accepting the invitation to visit the Yerkes Observatory took the train together and went to Williams Bay, from which place come reports of further pleasant experiences.

The abstracts of the papers are given below, arranged, as heretofore alphabetically according to authors.

ABSTRACTS OF PAPERS.

A STAR WITH AN EXTRAORDINARY VELOCITY IN SPACE.

By W. S. Adams.

The radial velocity of the ninth magnitude star Argelander-Oeltzen 2, 14320 ($\alpha = 15^h\ 5^m$) is found to amount to $+290$ km per second. If this value is combined with the annual proper motion of $3''.76$ and the parallax determined by Russell, the motion in space of the star proves to be 577 km, directed toward the apex

$$\alpha = 12^h\ 35^m.\quad \delta = -70°.$$

THE FLASH SPECTRUM WITHOUT AN ECLIPSE.
REGION λ 4800 to λ 6600.

By W. S. Adams and Cora G. Burwell.

A study of the chromospheric spectrum as photographed with the 60-foot tower telescope leads to the following conclusions:

1. The number of bright lines photographed (1193) is slightly in excess of the number photographed by Mitchell at the eclipse of 1905. The average deviation of the measured wave-lengths from those in Rowland's table is 0.012 Ångström; for the eclipse results in this region they are 0.030 Ångström.

2. Double reversal is a universal characteristic of the stronger lines.

3. The chromospheric results relate to a lower level in the solar atmosphere than the eclipse results.

4. Some remarkable differences have been found in the dark line spectrum at the Sun's limb. Among these are the appearance of certain new lines not found in Rowland's table; the presence of what appears to be a band spectrum to the red of λ 6100; and the strengthening and weakening to an extraordinary degree of many of the solar spectrum lines.

SOME SPECTRAL CRITERIA OF ABSOLUTE STELLAR MAGNITUDES.

By W. S. Adams and A. Kohlschütter.

A study of the spectra of two groups of stars, of which the first is made up of stars which are comparatively near, of small brightness, and probably small mass, and the second of distant stars of great brightness, and probably great mass, gives the following results:

1. The continuous spectrum of the more distant stars is relatively weak in the violet. The weakening appears to be a function of spectral type, and so must be considered in large degree an absolute magnitude effect.

2. Abnormally strong hydrogen lines are found in many of the more distant stars. The additional selective absorption is proved by radial velocity measures to take place, not in space, but in the stellar atmospheres.

3. A number of spectrum lines have been found, some of which are relatively strong in the distant or high luminosity stars, and others in the near and comparatively faint stars.

The relative intensities of these lines have been used in a quantitative way for the determination of the absolute magnitudes, and hence parallaxes, of 162 stars of types ranging from F8 to K9. The values found compare favorably with those derived from measured parallaxes and proper motions.

THE ORBITS OF THE BINARY SYSTEMS β 794, β 1111, β 1266, AND β 1270.

By R. G. Aitken.

Sufficient data are available for first approximations to the true orbits of the four stars mentioned in the title. The elements and notes on them are given herewith.

Name / Elements	**5951** β794	**6842** β1111	**12404** β1266	**6711** β1270
	y	y	y	y
P	42.0	44.32	36.0	32.5
T	1914.25	1920.4	1911.35	1912.2
e	0.50	0.15	0.24	0.42
a	0″.345	0″.26	0″.24	0″.22
ω	225°.0	146°.3	163°.0	12°.15
i	± 52°.75	± 46°.4	± 62°.15	± 38°.7
Ω	109°.2	42°.9	59°.1	156°.6
Angles	Increase	Increase	Decrease	Increase

β G.C. **5951**, β794. Though the observed arc at the time of my last measure in 1912 was 170°, both ends of the apparent ellipse are so clearly indicated that the orbit, obtained by graphical methods, should be a fair approximation.

It is at present an exceedingly difficult object to measure, for the angular separation is but little more than 0″.10. According to my elements this will not vary more than 0″.01 until 1916, after which it will increase rapidly. It deserves more attention than has been paid to it in the past.

6842, β1111. This close pair, discovered with the 36-inch telescope in 1889, forms the fainter component of the 6″-pair, Σ1835. The wide pair has shown no material change since the first measure by Herschel in 1781, but the close pair is in rapid motion, the total observed arc, including my measures in the present year, being 170°. Inspection of the measures shows that the angular separation reached a maximum of 0″.29 about the year 1901, and this probably defines the apastron end of the apparent ellipse. Otherwise the pair would undoubtedly have been discovered during the earlier measures of the wider double The elements were derived by graphical methods, and were based entirely upon the measures with the 36-inch refractor by Burnham and myself. Indeed, I know of only four other measures, two by Lewis, one by Schiaparelli, and one by Burnham with the 40-inch.

12404, β1266. In 1891 Burnham found the principal star of Σ3018 to be a close double. This has shown rapid motion and the observed arc, including my measures of 1912, is 195°. This includes both ends of the apparent ellipse, but the elements are nevertheless probably less accurate than those given for the two preceding stars. This is due to the fact that the angular separation at maximum does not exceed 0″.25 and at minimum is not over 0″.10. The measures are, consequently, somewhat discordant.

6711, β1270. This close and difficult star was discovered with the 36-inch telescope in 1892. Since then it has been measured only with that instrument and with the 28-inch at Greenwich. The observed arc,

in 1912, amounted to 200°, and the elements were computed at that time. At present the angular distance is near its minimum value, and measures are therefore very difficult, even with the great refractor.

It may be of interest to note that, counting the four just given, we now have orbits for 19 of the β-stars. One of these, the orbit of β80 is certainly erroneous, and two others, those of β962 and β552, are very uncertain. The remaining sixteen include seven with periods under thirty years and only two with periods in excess of fifty years (β648, P = 51 years, and β513, P = 53 years). This is certainly a very remarkable showing, especially when we consider that the observations of the β-stars extend over, at most, periods of from 20 to 40 years. All other double star catalogs combined have, to the present time, given us only six binaries with periods under thirty years, and eight more (nine, if Procyon is included) whose periods are less than 50 years.

Many other β-stars have been observed through arcs exceeding 90° and measures of these pairs in the next ten years will certainly add largely to the list of β-stars with computed orbits. Though my own discoveries are twice as numerous as Burnham's and include a higher percentage of very close pairs, I consider it doubtful whether they will yield as high a percentage of rapid binary systems.

ON THE NUMBER OF THE GLOBULAR CLUSTERS.

By S. I. Bailey.

Nebulous celestial objects were known to the ancients; but apparently these included no globular clusters, although several of the largest are visible to the naked eye. The lists of nebulae and clusters discovered by Messier, Dunlop, the Herschels, and a few others, appear to include practically all globular clusters now known. During the last half century, so far as the writer is aware, no new cluster surely globular has been discovered, although the number of nebulae and stars has been enormously increased. The writer wishes to raise the query, whether the number of the globular clusters may now be considered practically complete, so that a definitive study can be made of them. More information is desired in regard to the extremely faint, condensed, nebulous objects which may be seen in telescopes of the largest size, and which are found on photographs of very long exposure.

PHOTOGRAPHIC MEASURES OF SATURN AND ITS RINGS.

By E. E. Barnard.

Measures were made of the ball and ring system of the planet Saturn on photographs taken by the writer with the 60-inch reflecting telescope

at Mount Wilson, 1911 November 19. The exact scale of the photographs is not known. This, however, does not affect the value of the measures to show changes that may take place in the Saturnian system in the future. For convenience the measures are all referred to the mean diameter of the Cassini division in ratios of that quantity, the Cassini division being the most strongly marked feature of the system. In these measures no sensible eccentricity was found to exist in any of the elements of the ring. Visual measures made in 1894-5 also fail to indicate any eccentricity.

These photographic measures show some small difference from the visual measures, which is not believed to be due to changes in the system of Saturn.

In *Monthly Notices* of the Royal Astronomical Society for 1914, June, Mr. Patrick H. Hepburn calls attention to the fact that these photographs show the ball of Saturn through the outer ring, which is therefore transparent, like the inner or Crape ring.

VISUAL OBSERVATIONS OF SOME OF THE HARVARD COLLEGE OBSERVATORY POLAR SEQUENCE STARS, MADE WITH THE 40-INCH REFRACTOR OF THE YERKES OBSERVATORY.

By E. E. Barnard.

In the summer of 1912 visual observations of some of the Polar Sequence Stars (H. C. O. Circular 170) were made with the 40-inch refractor, to determine the faintest stars that could be seen with the large telescope. The following table shows some of the stars observed, their estimated magnitude, etc.

Number	H.C.O. Magnitude	Estimated Magnitude	Notes
31	16.08	14.1	Very easy
34	17.11	15.2	Very easy
17s	16.97	14.4	Very easy
18s	17.86		Seen faintly, but the star 15s interferes
19s	18.30	16.4	Held steadily, but very faint

According to this list, the faintest star visible in the large telescope was *19s*, whose brightness from the H.C.O. Circular is 18.30 magnitude. This star, though faint, was held steadily.

Upon sending these results to Professor E. C. Pickering he suggested that I try the region of the stars BD + 15°2541 and 2542, and report the faintest stars seen. No long exposure photograph was to be used, so that it really meant that the faint stars had to be actually discovered

and measured. The results of this investigation were shown in the lantern slide. These stars were not only found without any guide, but they were measured with the micrometer. Following are some of the faintest of the stars found here. Upon sending the list to Professor Pickering, he kindly supplied me with the H.C.O. magnitudes of the stars.

Number	E.E.B. Magnitude	H.C.O. Magnitude
9	14.2	17.04
13	14.9	17.77
19	15.8	18.3?
24	15.0	17.54
27	14.7	17.02
28	15.0	17.07
29	$14\frac{3}{4}$	17.07
34	15.0	17.02
38	15.5	17.02
39	16	17.39
40	15.6	16.97

The assumed limit of the 40-inch telescope has been 17th magnitude, upon which my magnitudes were based. Ten of these stars seen and measured are below the theoretical limit of the 40-inch telescope—one them was 18.3 magnitude.

The conclusion of Professor Pickering from these observations was that these fainter stars are probably red.

ON THE EARLY SPECTRUM OF NOVA GEMINORUM OF 1912.

STORRS B. BARRETT.

The very weak and narrow absorption lines measured by Ludendorff and by Giebeler and Küstner have been ascribed, with some hesitation, by them to various elements after allowing for a displacement of about +20 kilometers. It is here attempted to show that these lines are only details in the structure of the numerous broad absorption bands which have a displacement of about —500 kilometers. Measurements of the plate taken with the Bruce spectrograph of the Yerkes Observatory, with one prism, on March 15, 1912, indicate that there is such a structure—already previously noted by Campbell and Wright in the case of Nova Persei.

A tabulation of 90 bands identified with chromospheric lines as given by S. A. Mitchell for the eclipse of 1905, shows the presence of at least seven structural lines in each band, separated by about 1 Ångström from each other. The lines measured by Ludendorff and those on Giebeler's plate of March 16, comprising all that have been examined so far, lie well within the boundaries of these bands and can be con-

sidered therefore as merely parts of the bands, although it would be reasonable to suppose that at least some of them may have the same origin as that of the strong absorption lines of H and K of calcium.

In contrast to the majority of the absorption bands are those of hydrogen and of H and K of calcium. These are twice as broad and are very strong. As these very broad bands divide later into two bands, it is probable that they are, even as early as March 15, in reality only two bands in juxtaposition. Now, if we do regard them as consisting of two equal bands side by side and compare their displacements with those of the narrower bands discussed above, it will be found that the less refrangible, and by far the stronger, halves correspond precisely with these narrower bands. The question then naturally arises whether every band does not have a weaker, more refrangible companion, hitherto unrecognized because of its weak intensity. A search has accordingly been made for faint companions to the stronger bands with some indications of success.

Attention is called to the apparently regular spacing of the structural lines to correspond with 1 Ångström, which suggests an interference phenomenon.

THE DISTRIBUTION OF THE ASTEROIDS.

By S. G. Barton.

The asteroids were carefully arranged in order of increasing inclination. For each degree of inclination the averages of the values of each of the other elements ω, Ω, ϕ, and μ was taken to show any correlation which might exist between the elements. The summary of all of this work is shown in the accompanying table. The first column gives the degree of inclination, 6° for example meaning all inclinations between 6° and 7°. The second column gives the number of asteroids having that inclination, the third the average ω for that inclination, etc.

As was shown by Kirkwood for a much smaller number of asteroids, the eccentricity and inclination increase together. The present exhibit, based upon the 714 asteroids of the Berliner Jahrbuch for 1914, confirms this. A mere glance at the table shows it. Thus the mean ϕ for the first two groups, 43 asteroids, is 7°.0; for the last 11 groups, also 43 asteroids, the mean ϕ is 11°.2.

Another point, not heretofore noticed, I think, is seen in the μ corresponding to an inclination of 5°. At the bottom of each column the average value of the elements, including all the asteroids, is shown. The average μ is 780″. The average for an inclination of 5° is 884″. This value 884″ is the largest in the column without exception; moreover it

is the average for 51 asteroids, the largest number in any group except that for 6°, which contains 54. Thus we should expect to obtain very nearly the average value 780″ from this group. Thus there seems to be good reason for thinking that the large mean motion, that is, small major axis, corresponding to an inclination of 5° is not accidental. There are ten values of μ larger than any in this group, and 27 smaller than any in this group, so that it is not exceptional values which give rise to the large general value. The groups on either side are normal.

The asteroids were similarly arranged with respect to increasing eccentricity, being grouped for each degree of ϕ as shown. This table shows that i increases with ϕ and also that μ increases with ϕ.

It was the intention to arrange the asteroids with respect to the other elements but this is not being done, so the work is presented in its present state.

SOLAR RADIATION AND TERRESTRIAL MAGNETISM.*

By L. A. Bauer.

Good progress has been made by various investigators in establishing the relationship between fluctuations of the Earth's magnetism and those of the Sun's activity during the sun-spot cycle. The magnetic quantity most frequently used for this purpose has been the range of the diurnal variation of the Earth's magnetism—generally of the magnetic declination. In connection with a preliminary examination of this relationship made five years ago in response to an inquiry received from Professor Hale, director of the Mount Wilson Solar Observatory, I had occasion to employ various other magnetic quantities. One of these was what is here termed the "local magnetic constant," which, under certain assumptions, is proportional to the magnetic moment of the Earth, or to the intensity of magnetization. The desire was to use for the examination a quantity yielding results which might be more readily susceptible of a physical interpretation than those generally obtained.

Possibly the most interesting result of this previous investigation was, that *increased* solar activity, as indicated by increased sun-spot frequency, was accompanied in general by an apparent *decrease* in the Earth's magnetic moment, or intensity of magnetization.

I have just completed a preliminary investigation, with the aid of Abbot's published values of the solar constant, showing that *increased*

* To appear in full in the September issue of the Journal *Terrestrial Magnetism and Atmospheric Electricity.*

solar radiation is also accompanied by an apparent *decrease* in the Earth's local magnetic constant or intensity of magnetization. A ten per cent change in the solar constant corresponds to a change of about $\frac{1}{30}$ per cent in the magnetic constant.

If the solar radiation really varies in the remarkable manner indicated by Abbot's observations, and if later investigation confirms the fact that there are observable changes in the Earth's magnetism, associated with changes of solar radiation, then it is not surprising that magnetic observatories should continually be recording magnetic perturbations, even on apparently undisturbed days. The most interesting of these are the very small oscillations, called by Eschenhagen "elementary waves," and by van Bemmelen "magnetic pulsations," forever being recorded even during periods of absolute solar calms, if gauged by absence of sun-spots.

The period of these pulsations may be only a few seconds, and the amplitude a few units in the fifth decimal (C.G.S. units,) or even but fractions of a unit, in the horizontal intensity, for which element they are most pronounced. The amplitude of the magnetic constant might thus be a few units in the sixth decimal C.G.S., corresponding to changes in the polar radiation of but a few tenths of a per cent, which, judging from Abbot's figures, may be an easily possible fluctuation. It would take stationary waves, for example, caused by solar explosions, to pass back and forth across the Sun's disk about the same number of seconds as is at times the average period of these magnetic pulsations. In brief, we may possibly find in the oscillatory character of the solar radiation a sufficient cause for the Earth's magnetic pulsations. However, the effect is too small to account thus for the much larger perturbations, experienced during magnetic storms, for which the change in the magnetic constant may be 10 to 100 times that above found for the maximum change in the solar radiation thus far recorded.

NOTE ON THE RADIATION FROM STARS.

By W. W. Coblentz.

Through the courtesy of the Director of the Lick Observatory and the Director of the Bureau of Standards I have had the privilege of testing the sensitivity of various stellar thermo-elements which replaced the plate holder of the 36-inch Crossley reflector. The thermo-elements were made of bismuth and platinum, also of bismuth and bismuth-tin alloy, with receivers 0.3 to 0.4 mm, mounted in suitable glass vessels kept evacuated by means of metallic calcium contained in "quartz-glass" tubes. The windows were of fluorite. The evacuated instruments

were carried from Washington, D.C., a distance of 3100 miles without mishap.

The galvanometer was an iron-clad Thomson instrument of sensitivity $i = 2 \times 10^{-10}$ ampere. It was mounted on the south pier which supports the reflector and was sufficiently steady to permit reading the scale to 0.2 mm. With this equipment quantitative measurements were made on stars down to the fourth magnitude and good qualitative measurements to the fifth magnitude. With a little effort red stars of the sixth magnitude could have been observed radiometrically. The deflections observed varied from 8 cm for Arcturus (magnitude = 0.2) to 0.10 cm for HR 7676 Draconis (magnitude = 5.4.) Venus gave a deflection of 22 cm, which under standard conditions would have amounted to 70+cm.

As standards of radiation, Arcturus, Vega, Altair, and γ Draconis were used in testing the radiation sensitivity of the instruments.

The radiation from about three score stars has been measured, and apparently it is merely a question of time and of physical endurance in order to extend the work.

A general survey of the data at hand indicates that:

(1) The individual stars of a given class (say "Class F") having the same photometric brightness differ somewhat in the amount of radiation emitted. This no doubt is to be expected.

(2) The various classes of stars differ greatly in the amount of radiation emitted. The blue stars (Classes B and A) radiate much (50 per cent) less energy than the yellow solar stars (Class F and G). and the latter in turn, emit less radiation than the red stars (Class M). The data thus far collected show no exceptions to this general classification. In Class M two stars (β *Pegasi* and α *Herculis*) are conspicuous for what may be termed an excessive amount of radiation emitted in proportion to their photometric brightness. Instead of causing a galvanometer deflection of say 5 to 6 mm, they produced deflections of 2 to 3 cm—depending of course upon the galvanometer sensitivity.

The intensity of the radiation from the blue component BC(mag.=5.1) of γ *Andromedae* is perhaps only about one-half that observed from a red star HR 7676 Draconis (Class Ma) which has a photometric magnitude of 5.4.

To some, of course, the information gained radiometrically is not unexpected. The pioneering work of Nichols, fourteen years ago, showed that Vega and Arcturus, which have closely the same photometric magnitude, differ widely in emission. He found the ratio of the radiations; Arcturus to Vega = 2.2. My own observations for different atmospheric conditions give a ratio of 2.42. Of course no conclusions could be drawn from observations on a single pair of stars, and the present generalization based upon measurements of over three score

celestial objects may require some modification. However, thus far no exceptions have been found under the conditions observed, viz., stars close together, same air mass, etc.

There is nothing inconsistent with the view that the blue stars may be the hottest. The total radiation received from a star is a function of its distance, size, temperature, and especially of its emissivity. The latter is a function of the kind and the physical condition of the material which forms the radiating layer of the stellar surface. Recalling the experiments on the variation of the emission with thickness of the radiating layer of an acetylene flame, and of the Welsbach mantle; recalling also that in the spark discharge (in which the highest terrestrial temperatures are supposed to obtain) the maximum emission is in the ultra-violet, that in the arc and also in the discharge through gases in vacuum tubes, the maximum radiation lies just beyond the visible (red) spectrum, and that the total radiation from the arc discharge is far in excess of the total radiation from the spark discharge, it is not difficult to conceive that a slight change in temperature may cause a marked change in the "color" and in the total radiation from a star.

The discussion of other radiometric observations, such as the amount of radiation transmitted by an absorbing solution (also the radiation from the dark and bright bands of Jupiter, which differ widely radiometrically in the amount of light reflected,) will be given in a detailed paper. In the mean time it is a pleasure to acknowledge my indebtedness to my colleagues, and especially to the assistants, Messrs. Nicholson and Green, detailed to operate the reflector.

Appendix. Dr. Coblentz adds in a subsequent letter that an absorption cell of water 1 cm in thickness transmits 27 to 32 per cent of the total radiation from red stars (Class M) and 45 per cent from solar stars (Class F and G) and 65 to 70 per cent from blue stars (Class A); also that he has measured the radiation of 112 objects, stars to the 7th magnitude, Saturn and his rings, etc.

A COMPARATIVE STUDY OF FILAR MICROMETER MEASURES OF DISTANCE.

By G. C. Comstock.

The systematic errors of micrometer observations have been elaborately investigated in connection with the observation of double stars but, so far as the writer is informed, these investigations are all limited to stars of small angular distances one from another. In connection with work upon the proper motions of faint stars, I have found it necessary to investigate systematic differences that may inhere in my observations of much wider stars and I have adopted as the best avail-

able material for this purpose a series of nearly simultaneous observations of 82 stars by Lau, Burnham, and myself, made about the epoch 1910. Adopting as a standard system the mean results obtained by the three observers, I find for the measurement of position angle, by intercomparison, that the systematic differences from the mean are, in the case of each observer, less than the probable error of their determination: i.e., about one minute of arc. In the measures of distances, there appear to be small systematic corrections required for reduction to the mean Burnham's correction being $+ 0''.10 \pm 0''.02$ at all distances from $50''$ to $250''$. The corresponding corrections for Lau and Comstock are negative and about one half the above amount.

This material has also been discussed for determinations of probable error of observing, the final result being that the probable error of a single observation is practically the same for all observers and for a single observation is roughly $0''.15$ of arc in distance and about $0''.25$ of arc in position angle. The latter value corresponds to a distance of $100''$ between the stars. A somewhat unexpected result is that in every case the precision of observing in distance is markedly greater than the corresponding precision in position angle.

THE MERIDIAN MARKS OF THE NINE-INCH TRANSIT CIRCLE OF THE U. S. NAVAL OBSERVATORY.

By W. S. Eichelberger and H. R. Morgan.

The meridian marks used in connection with the 9-inch Transit circle consist of small holes in castings bolted to capstones on brick piers. The north pier is 3x3 feet, and 3 feet high, and is sheltered in a house 10x10 feet, and 7 feet high, with closed double walls of matched lumber. The south pier is 3x5 feet by 3 feet high, and sheltered in a house 7x9 feet, by 7 feet high, made of Louvre work.

Electric lamps placed behind the marks, and a few feet from them, to furnish the illumination, are controlled by switches in the transit circle house.

The mark lenses, mounted on the collimator piers in the transit circle house, and 12 feet from the center of the transit circle, have focal lengths of 380 and 393 feet.

These lenses have occasionally been moved, between parallel guides, by means of fine screws; and the amount of motion has always been accurately known.

The methods used in deriving the azimuths of these marks from observations of pole stars, for the period September, 1903 to April, 1911, have been indicated in the *Astronomical Journal*, number 667.

The mean positions of the marks were taken for periods of a few weeks at a time; and the average number of observations of pole stars used to determine these mean positions was 22. These group means as depending on the fundamental positions of the pole stars derived from this work itself, and on observations corrected for personal equation of the observers, were shown on a diagram.

The probable error of a plotted position is $0^s.003$.

The diagram showed five curves. The first three represent the positions of the north mark, the positions of the south mark, and the theoretical motion of the marks in azimuth, as given by the results of the International Latitude observations. The larger amplitude of the theoretical motion in the later years was distinctly shown by the observed positions of both marks, the amplitude of whose motion is appreciably larger than the computed motion. The agreement between the observed and computed motions of the marks was more clearly shown by the fourth and fifth curves, wherein, after abstracting the computed motions, the variations of the positions of the marks from mean positions for the eight years (represented by the straight lines), was shown. The deviations in these curves, while largely accidental, are similar for the two marks.

There is a distinct change in both marks at the end of 1905, which may, or may not, be accounted for by an extreme cold spell. The difference between the average positions of the marks for 1904 and 1905 is about $0^s.05$.

The observations in the summer of 1909, and 1910, were mostly in the daylight, and the positions of the marks may be affected by this fact.

From an examination of some 1,000 observations no difference was found for the positions of the marks morning and evening.

The variation in the mean azimuth of the two marks from group to group, for continuous observations, seldom amounted to $0^s.02$.

This stability of the marks is considered very satisfactory, and as there is a pronounced variation in the azimuth of the instrument with daily variations in temperature, there has been a great advantage in the use of the marks for determining the instantaneous azimuth of the instrument.

THE SOLAR ROTATION PERIOD FROM MEASURES OF CALCIUM SPECTROHELIOGRAMS.

By Philip Fox.

This paper gave the final results for the solar rotation values from measurements of 3811 points on calcium flocculi on 285 plates obtained with the Rumford spectroheliograph. The plates were measured on

the globe measuring machine described in earlier reports of this work. The values obtained and, for comparison, the earlier results from measures of the Kenwood spectroheliograms are given in the following table. The two series are in excellent agreement.

Zone	ξ	P	ξ Kenwood
° °	°	d	
0 to 5	14.56	24.72	14.66
5 10	14.51	24.81	14.52
10 15	14.38	25.03	14.37
15 20	14.29	25.19	14.22
20 25	14.13	25.48	14.12
25 30	13.96	25.79	13.90
30 35	13.77	26.14	13.76
35 40	13.38	26.91	
40 45	12.72	28.30	

SPECTROGRAPHIC OBSERVATIONS.

By Edwin B. Frost.

Results were given from the measurement of three spectrograms of the Algol variable *RX Herculis* (magnitude 7.1 to 7.7), showing that the lines of both components are visible in the spectrum. The range in velocity is large, the extreme positive value being + 84km, the negative − 130 km.

The star 50 *Draconis*, which is of type A, magnitude 5.4, was offered for adoption for further study by some observatory specializing in spectroscopic binaries. Lines of both components are visible, the doubling occuring on alternate nights. The period is close to 4.1 days. The widest separation measured on the ten plates thus far obtained corresponded to a relative velocity of 175 km: −113 and + 62 km.

Reference was made to the determination, in collaboration with Miss Frances Lowater, of the wave-lengths in the star 10 *Lacertae* of certain lines useful in radial velocity work, e.g., silicon λ4089.12, the *N* line at λ4097.55, the line at λ4116.33, and the lines attributed to hydrogen at λ4200.3, 4541.9, and 4685.90.

THE POLARITY OF SUNSPOTS.

By George E. Hale and Ferdinand Ellerman.

The use of a quarter-wave plate, either single or compound, and a Nicol prism before the slit of the 75-foot spectrograph of the 150-foot tower telescope affords a convenient and reliable test of the polarity of sunspots.

Cases of opposite polarity in the two hemispheres have already been reported; but similar differences also occur in the same hemisphere.

To unify these results and exhibit the law governing the distribution of polarities, it is necessary to note that spots frequently occur in pairs in which the preceding spot usually appears first. Further, many single spots are followed by trains of calcium or hydrogen flocculi. The recognition of these as the principal members of imperfectly developed binary groups is essential. It is also necessary to discuss separately the results for the old cycle and for that now beginning.

The following can then be stated:

(1) The two principal spots of binary spot-groups are opposite in polarity.

(2) Preceding or (following) spots in northern and southern hemispheres are opposite in polarity.

(3) In each hemisphere the high latitude spots of the new cycle are opposite in polarity to the low latitude spots of the old cycle.

Among 49 cases there are but three exceptions to the above conclusions. The relation of the results to the semi-circular vortex hypothesis is also discussed.

THE ORBIT OF RZ CASSIOPEIAE.

By Frank C. Jordan.

This star was discovered to be an Algol variable by Müller and Kempf in 1906. The earliest spectrographic observations were made in the same year by Hartmann, who found a velocity range of 145 km. Seventy-one plates obtained at Allegheny in the years 1910 to 1913 were used in finding the orbit.

The spectrum is of the type A2, with a sharp K line, but very weak and diffuse metallic lines.

The elements of the orbit are as follows:

$$P = 1.19525 \text{ days}$$
$$e = 0.052$$
$$T = 1912, \text{ Feb. } 16.732. \text{ Epoch of Periastron.}$$
$$\omega = 154°.7$$
$$K = 69.30 \text{ km}$$
$$\gamma = 38.32 \text{ km}$$
$$a \sin i = 1137000 \text{ km}$$
$$\frac{m_s^3 \sin^3 i}{(m + m_s)^2} = 0.0412 \odot$$

The period is determined with a probable error of about 0.0000015 days.

The theoretical time of light minimum, or the time when $u = 0°$, occurs about fifty minutes after the observed time of the minimum. There is no difference in time between the light minima as determined visually and photographically. This is proved by the numerous visual determinations which are practically concurrent in time with the few observed photographic minima. It is further confirmed by two plates obtained with the Yerkes two-foot reflector, one an ordinary plate, the other a red-sensitive plate with a visual-luminosity filter. The minima as determined from these two plates are practically identical in time.

Reasonable assumptions as to the mass ratios of the two bodies of the system make them roughly of the size of our Sun.

To be continued.

THE DOUBLE CANAL OF THE LUNAR CRATER ARISTILLUS.

WILLIAM H. PICKERING.

This paper may be considered as a Supplement to the Monthly Report on Mars No. 5, published in the May number of this magazine. In that Report it was stated that the two components of the double canal appeared absolutely straight, uniform, and parallel, and that the lunar canal was of about the same angular breadth as those previously observed on Mars, and appeared just like them, with the exception that it was perhaps a little easier to divide. These observations were made with a magnification of 330, which is about the power usually employed by other observers on Mars. For this work it was found that 330 gave slightly better results than 660. Since these observations were made however the writer has received a new negative eye-piece, giving a magnification of 430, which enables him to throw a considerable amount of new light on the character of the formation in question. Moreover he has planned and constructed a device, which it will be more appropriate to describe in connection with his next paper on Mars, by which he is enabled to measure the breadth of the canals within $0''.05$. The first practical application of it however has been in connection with the canals of the moon.

The results of this more recent investigation are given below. They are given in rather minute detail, because it is thought possible that some of the readers of this article may be interested to follow them from night to night with their own telescopes. Although much which is visible here may escape them, yet undoubtedly a considerable part

can be seen even in the north, in spite of the poor seeing, by taking advantage of favorable nights, particularly during the winter months when the moon is high. The outer canals for instance have been observed here with our 3-inch finder, using a magnification of 180. The duplication of the inner canal on the other hand is beyond the reach of any but the larger telescopes, and not even of them unless the atmospheric conditions are very favorable. It has been seen here with an 8-inch aperture, but one should employ a magnification of at least 400 diameters.

FIGURE 1.

The Ephemeris for Physical Observations of the Moon, giving the Colongitudes for every night, for 1914, will be found at the end of the British Nautical Almanac. It appears also in the American Ephemeris for 1915. Aristillus is located one degree to the west of the central meridian. The colongitude, or apparent lunar time that the crater is crossed by the sunrise terminator, is consequently 359°. The colongitude of its noon is 89°, and of its sunset 179°. The colongitude is therefore analogous, it will be seen, to Greenwich Time for the earth. But since the lunar day is also its year, as far as seasonal changes on its surface are concerned, we may consider that colongitude 359° for Aristillus corresponds to our vernal equinox, that 89° is its summer solstice, and 179° its autumnal equinox. The latitude is +34°, so that its changes do not occur as rapidly as for those formations nearer the equator. Consequently, they are not so completely masked by the sunrise and sunset shadows, which is a very favorable circumstance. The diameter according to Neison is 34.4 miles (55.0 km.) The phenomena are therefore on a sufficiently large scale to be readily visible with a comparatively low power.

The writer feels the lack of a generally recognized nomenclature to designate certain features upon the moon, particularly those areas of considerable size which darken with the approach of the lunar summer, that is towards lunar noon, and fade out again in the lunar autumn, that is towards sunset. They correspond to the Martian "seas," but since that term is already in use on the moon for other and much larger objects, he suggests the term "fields", which has the incidental advantage over "canals", "lakes", etc., of indicating what is really meant, that is plains or slopes covered with some form of vegetation. In the accompanying sketch, Figure 2, while the whole of dark area to the northwest of Aristillus may properly be called a "field", yet for convenience in our description of the changes observed, the term will be restricted to that darker portion of it, which measures about five by ten miles, and lies directly north of, i.e. below, the canals. The original of this drawing was made July 26, 1912, colongitude 65°.9, but its proportions have been slightly modified by comparison with other drawings made since that date.

FIGURE 2

The barren and unchanging region to the south of the crater will be referred to as the "mare". Its brightness is constant, and is taken as five on the scale of ten. The brightness of two other regions has been estimated, the "floor" and the "inner fiield". The latter refers to that small portion of the inner slope of the crater lying directly between the "source", or point from which the canals originate, and the crater floor. It is of rectangular form in Figure 3. This region changes very notably in shape as the lunation progresses (See Figure 2). Between the "field" and the crater lies a bright triangular area which contains several more or less variable canals. Indeed, nearly all of the small dark areas on the moon are variable under high illumination, when

well seen, either in shape, or density, or both. Except in the case of a few small spots very near the equator, never has any variation been observed on the moon near the time of sunrise or sunset, that is to say near the terminator.

Nearly everyone who looks at the moon through a telescope confines his attention exclusively to these regions, because they furnish striking views, are easily identified, and because what is seen is easy to understand. It is largely due to this fact that the impression that the moon is lifeless has so long maintained its existence, in spite of the facts to the contrary. The only time when the moon is interesting, to one who is really used to its surface, is when changes are taking place upon it, and these only occur far from the terminator, that is during the lunar summer time. Then they are conspicuous all over the surface to any who will take the trouble to watch and to study them carefully.

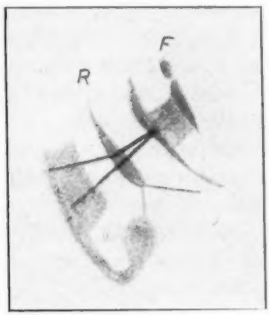


FIGURE 3.

To return to Aristillus, Figure 1 represents its appearance as seen September 27, 1914, at colongitude 14°.0. A low flat hexagonal crater which has been nearly destroyed by subsequent melting of the general surface is shown to the north. Within it faint shadows of what appear to be four low lying ridges are seen. Later a number of narrow bright lines, parallel to these ridges, appear in their place, together with another one crossing them at right angles, the intersections being marked by minute craterlets. Immediately to the southwest of the hexagonal crater, a few sharply defined ridges and hollows are shown by their shadows, showing that the country is of a rolling nature, but these soon disappear. The brightness of this region, which we have designated as the field, as shown in Figure 1 is 5, the same as that of the mare to the south of Aristillus, and it is of the same color. The floor of the crater receiving only a portion of the sun's light, is appreciably darker, but is of the the same grey tint.

As the sun rises higher the shadow within the crater shortens, and at about colongitude 17°.3 the inner canal is first detected, as a very dark nearly uniform band, width 0″.60, very sharp on its eastern edge, and connecting two regions still in shadow. There is no evidence as yet of duplication. Shorty before this occurs the two outer canals make their appearance as two straight extremely narrow dark lines, diverging at an angle of 29°, and reaching from the rim to the bottom of the outer slope, a distance of three miles. Their breadth is about 0″.05, corresponding to 300 feet. On the floor at the bottom of the inner slope are three small and very shallow craters. On the eastern rim nearly opposite the canal are two elongated bright spots, both of brightness 8. Before noon or midsummer, the smaller one fades and disappears, and soon after the larger one follows it, but in the meantime the whole northern and eastern rim becomes brilliant, and bright scattered patches form within the crater, chiefly in the vicinity of the canal. Two terrestrial days before sunset these too disappear. They are most conspicuous between colongitudes 60° and 130°. It should be noted that this formation and disappearance of bright spots along the rim, and over the floor of the crater is by no means peculiar to Aristillus, but occurs in numerous other craters all over the moon.

The first evidence of duplication of the inner canal was noted at colongitude 30°. This would be two and a half of our days after sunrise on Aristillus. It was not yet well marked, but could just be detected. The outer canals by this time had appreciably widened, to a little over 0″.10 and had perhaps also darkened. The outer field was but little darker than the mare, brightness 4.5. The long stripes extending from it towards the northwest were already beginning to darken.

By colongitude 45° the outer canals had rapidly widened to 0″.25, and were now very conspicuous, the field had clearly begun to darken, its brightness having dropped to 4, but the most interesting feature was the double canal, which was now perfectly distinct and appeared as in Figure 3, where R indicates the rim of the crater and F the edge of the floor. This drawing was made June 4, 1914, colongitude 47°.1. In it the canals are seen to start at a point half way up the inner slope of the crater, and to diverge at an angle of 9° until they reach the rim, where their distance from center to center is 0″.7. Their width is the same as it is outside the rim, 0″.25 or 1500 feet, and there is no enlargement whatever at their origin. Their length from their origin to the rim is five miles, from the rim to the bottom of the outer slope three miles, and they now extend three miles more out on to the mare, eleven miles in all. They appear as two perfectly straight and uniform dark lines. When not clearly defined, or when viewed with too low a power, they appear to be parallel as far as the rim. In this connection

it may be interesting to quote from the Bulletin No. 15 of the Lowell Observatory, which is devoted to the Double Canals of Mars, in which Professor Lowell says, "Similarly, with the exception of the Arnon and Kison, single canals alone are found north of 63° N. latitude. The exception too is pregnant. The Arnon and Kison are neither double nor single but wedge-shaped, their two sides inclined toward one another, tapering to the pole."

The outer canals grow steadily darker and more conspicuous until colongitude 40°. Their brightness from then until 90°, midsummer, ranges from 2 to 2.5, but their width never exceeds 0″.30. After that they suddenly begin to fade and become much less conspicuous, at the same time slowly narrowing. They are probably most conspicuous between colongitudes 40° and 50° and again between 75° and 85°. The reason they are not well seen between 50° and 75° is that the whole region between them has also darkened, though never quite equalling the canals. At midsummer, 90°, its brightness is about 2.5. The same is true of the duplication of the inner canal. It is most readily seen between colongitudes 35° and 65°. The intermediate space then darkens, and the duplication is not well seen again until about 110°. At 120° the canal begins to fade, and the duplication becomes more difficult until 145°, after which the canal appears as a faint uniform band, disappearing first at the top, and is entirely gone one terrestrial day before lunar sunset.

At colongitude 30° each of the outer canals fork, but the four branches are very faint. The next day they reach their maximum length of 24 miles from source to terminus. Besides the two main canals others are seen in the immediate vicinity, two of them descending from the rim are shown in Figure 3. In the dark region just outside the crater they are seen branching in all directions giving somewhat the effect of a country road map. In places one could scarcely travel three miles without crossing one. They are of all degrees of faintness from that of the two main canals already described, down to the extreme limit of visibility. The narrowest visible, however, can hardly be less than 200 feet in width.

The lunar atmosphere is very possibly considerably more dense than is generally supposed. We know but little about the refractive powers of very rarefied atmospheres when the mean free path of the molecule is of appreciable length. It is not likely however that its density exceeds a few millimeters, and in that case ice when warmed would pass directly into vapor without passing through the liquid form. However tempting the idea might be, and their appearance certainly suggests it, these canals cannot therefore be irrigating channels either natural or artificial.

Water might retain its liquid form if held beneath the surface of the soil by capillary attraction, but it is not clear how this would help to explain the markings observed. A fuller understanding of them would very likely give us material aid in our attempts to explain the canals of Mars; but it should be noted that these lunar canals are much finer angularly than the great majority of those seen upon Mars during the past apparition.

At colongitude 50° two bright streaks analogous to those surrounding Tycho, but much finer, appear in the region between Aristillus and Theaetetus. They are 15 to 20 miles in length, and the northern one is not over a mile in width. The southern one seems to be composed of two or more combined. They are comparatively faint and are not long visible. The inner field which begins as a broad rectangle when the sun first strikes it gradually narrows, becomes pear-shaped about colongitude 30°, later narrows to a line, then throws out a broad branch towards the south at 100°, and finally fades out and disappears before sunset.

Definite colors are recognizable in this region of the moon, although they are not strongly marked. Excepting towards sunrise and sunset the floor of the crater is slightly more yellow than the mare, while the field as it darkens assumes a bluish shade of grey, tending to purple when darkest. It is never the rich purple black, however, that is found at the foot of the Apennines near Bradley, nor in Boscovitch, nor is the color ever as marked as in Plato.

The writer had expected in this paper to present the results of observation of this region at several other observatories, but has not secured as much as he had hoped to obtain. Professor Barnard wrote that he had not done any observing of late, but expected soon to be able to look into the matter, and expressed great interest in it. Professor Lowell was away from Flagstaff, but kindly referred the matter to one of his assistants Mr. E. C. Slipher. The latter examined the crater and sent a drawing and some notes. The observations were made April 13 and 14, at 16^h M.S.T. These dates would correspond to colongitudes 135°.9 and 148°.1, which would be after the outer canals had faded, and the inner canals had more or less coalesced. He saw but little, and attributed that to shadow. Had he watched the inner canal only one day longer, he would have seen that as the sun sank lower, the supposed shadow would have disappeared!

Professor Aitken has examined the crater several times with the 36-inch, first on June 8. If the observation was made at midnight, this would correspond to colongitude 102°.3, or just as the second doubling of the canal was beginning. The observation could hardly have been made later than colongitude 105°. He used several powers

from 270 to 1000, with a shade glass to protect his eyes from the glare, and says "I saw the marking much as you describe it except that I could not detect any doubling. The dark streak ran from near the central cone of the crater over the edge N.W., and branched there into an irregular inverted Y." He observed the crater again in July and August under rather unfavorable conditions, but saw nothing more than in June. I have suggested to him that he try the 12-inch, since unless the seeing was phenomenally good, it would probably give better definition, and show more, than the larger telescope.

With regard to other cases of double canals upon the moon, Pytheas appears to exhibit one at certain times, as does Seleucus, but they need further study, and are not so satisfactory as Aristillus, although their components appear to be more nearly parallel. Several of the snow craters show straight narrow canals. One of the best marked is Maury. The canal there is six miles long, perfectly straight and uniform, and 0″.3 or 1800 feet in width. It appears to be double, but is too difficult to resolve with an 11-inch telescope even under perfect atmospheric conditions.

In summarizing our observations it cannot be impressed too strongly on the reader that neither the dark fields nor the canals owe their blackness to shadow. Shadows are most conspicuous at lunar sunrise and sunset, and are absolutely invisible at full moon. These markings are invisible at sunrise and sunset, and are most conspicuous at full moon. Since the outer canals are wholly invisible at sunrise, though the region is well shown, and the inner ones are similarly invisible at sunset, they cannot be due either to troughs or ridges. The blue black color of the fields and canals can only be due therefore to a discoloration of the surface, which develops alike on slopes and levels in the lunar summer, and is invisible in the spring and autumn. We know of no mineral which acts in this manner, and the only possible explanation therefore seems to be that it is due to a covering of vegetation.

Scarcely any professional astronomers look at the moon now-a-days; it is left wholly to amateurs. Many astronomers write text books on astronomy. New editions are constantly being brought out in which they repeat the well worn statement that "the moon is without air, water or vegetation." It is impossible for a single writer to make headway against such odds. Statements and facts relating to bodies like the moon and Mars, which few astronomers ever look at, make progress but slowly. This is because the text-book astronomers never read them, nor do they believe the observers, if they do. There are too many other things that they must read.

In a few years Schiaparelli's first announcement of the discovery of canals on Mars will reach its fortieth anniversary, yet even at the present day it would not be difficult to find many astronomers both in Europe and America who would be prepared either to deny their existence altogether, or to express grave doubts with regard to it.

The writer first began advocating the existence of vegetation on the moon a little over twenty years ago, and has been writing about it ever since. Other astronomers had sgugested it before him, but for the last hundred years the matter has been somewhat in abeyance, the last prominent astronomer who strongly favored being Sir William Herschel. The writer hopes that in another twenty years the idea will have gained some currency, but alone, without the help of others, it is hopeless to expect to accomplish much.

It does not seem as if it would be a matter lacking entirely in interest to the public. Neither do the necessary observations require the highest grade of seeing, nor the largest telescopes. In this respect the lunar fields differ markedly from the martian canals. The dark field near Aristillus can be watched in process of darkening with a 3-inch telescope or even one that is smaller. This is the most striking feature of the whole series of phenomena connected with the crater, and the change in brightness is very marked. The changes in Eratosthenes described in the Harvard Annals **53** can be observed regularly taking place at their appointed seasons with the same instrument, although as far as the writer is aware no one has ever verified any of them, or at any rate has not published an account of it. There are plenty of other regions on the moon showing similar conspicuous changes that are still undescribed.

The professional astronomer has no interest in these matters. It is the opportunity of the amateur. But it is of no use for him simply to watch these changes himself. What he should do in order to be of some use is to make his observations and drawings with care, always recording the times, and computing the corresponding colongitudes, *and then put his results in print.* Let everyone do his share, even if it be but little, and when enough has been printed, from enough different observers, so that it becomes a matter of common knowledge, we shall at length nail that ancient falsehood that "The moon is a dead planet."

PLATE XXVII

DELAVAN'S COMET 1913 *f*, 1914 SEPTEMBER 30,
$14^h\ 30^m$ TO $16^h\ 15^m$ C. S. T.

Photograph by Lewis L. Mellor, with a camera of 3.6 inches aperture and focal length of 20 inches, at the Detroit Observatory, Ann Arbor, Michigan.

A PHOTOGRAPH OF DELAVAN'S COMET.

LEWIS L. MELLOR.

On September 30, 1914, Delavan's Comet *f* (1913) was photographed with a camera, having a focal length of twenty inches and an aperture of three and six-tenths inches, attached to the six-inch refracting telescope of the Detroit Observatory. Owing to the unfavorable position of the comet, an exposure of an hour and three-quarters only (from 14^h 30^m to 16^h 15^m C.S.T.) could be obtained. In the photograph shown, which was made from a two-fold enlargement of the original negative, the process of intensification has destroyed the minor details of the head. For several weeks past, whenever weather conditions permitted, the comet has been observed telescopically and at all times the nucleus has presented itself as a sharp, star-like, condensation.

The negative shows that the comet possesses two tails, the northern one about ten degrees in length is very narrow and yet shows considerable structure, while the southern one is ill-defined and bushy with very little detail. Near the head the northern tail is decidedly intense and slightly curved, becoming spiral in form for a distance of about seven-tenths of a degree, after which it bends towards the southern tail for an equal distance but gradually shifts back to its former path, where it assumes a fork-like structure, made up of faint diverging streamers.

A most important feature about this comet is that it presents two tails not far different from one another in photographic intensity; and that the northern one is characteristic of tails usually found in small comets, while the southern one is characteristic of those found in large comets. Evidently the conditions capable of producing these two distinct types of tails have been working simultaneously.

Detroit Observatory, Oct. 13, 1914.

HOW TO FIND THE CONSTELLATIONS.

[*Continued from page 498.*]

Ursa Minor (The Little Dipper.)

The Pole Star is in the handle of the Little Dipper of seven stars, corresponding in shape to the Big Dipper; but it does not resemble a dipper so closely as does the group of stars forming the Big Dipper, for the handle is attached to the bottom of the bowl instead of to the top. The two stars in the Little Dipper corresponding to the pointers in the Big Dipper are sometimes called the "Guardians of the Pole."

The Pole star itself is the most important star in the heavens to navigators, who use it to find direction. As the altitude of the Pole always equals the latitude of the observer, whenever the Pole star is in sight navigators know at once in what latitude they are. The use of the Pole star for this purpose dates back to the time of the Phoenicians.

Mythology tells us that Ursa Major and Ursa Minor represent the nymph Calisto, whom Jupiter loved, and her son Arcos, both of whom Juno turned into bears. Thereupon, Jupiter who could not restore their forms placed them among the stars. Calisto was Ursa Major, Arcos, Ursa Minor.

Draco (The Dragon.)

The Dragon is found winding about between the Big and Little Dippers. The end of the tail lies between the pole star in the Little Dipper and the pointers in the Great Dipper. The rest of the Dragon is outlined by faint stars curving around the Little Dipper. The neck and head of the dragon turn back upon itself away from the Little Dipper. The head of the Dragon is composed of four stars, which form a roughly shaped diamond.

There are different accounts of the constellation Draco given by the mythologist. It is represented by some as being the watchful Dragon, which guarded the golden apples in the garden of Hesperides and was slain by Hercules. These apples were presented to Jupiter by Juno and as a reward for its faithful services the Dragon was placed among the stars. Another mythologist says that when the Olympian gods made war on the giants of earth, Minerva was opposed by the Dragon. She seized it and hurled it up into the sky and it became entangled with the axis of the heavens before it had time to unwind its coils.

This constellation is composed of faint stars and is therefore not easily found, but the stars composing it are very nearly equally distant from each other.

Cassiopeia.

Cassiopeia lies on the other side of the Pole star from Ursa Major and almost directly opposite the Big Dipper. In this constellation seven stars form a figure somewhat like a chair in shape. The little star on the front edge of the chair is very faint and on account of this it is often left out of consideration, and the outline of a distorted "W" is imagined. At certain seasons of the year the outline of the chair is more clearly defined than at others. The chair is tilted at an uncomfortable angle, and the queen appears in the un-queenly attitude of standing on her head.

There are only two stars in Cassiopeia that are known by individual names. The star Alpha, marking the front leg of the chair, is sometimes known as Schedar or the heart. The other, Beta, marking the back leg of the chair, was formerly called Caph or the tinted hand.

The constellation of Cassiopeia is indeed an interesting one, and may be found without much difficulty.

Cepheus.

Between Draco and Cassiopeiae is Cepheus, the queen's husband. He stands with one foot on the pole star, his head reaching to the Milky Way and his uplifted right hand extending toward Albireo in the foot of the northern cross.

This is an indistinct constellation. Three rather bright stars in a row mark Cepheus' head, belt and left knee.

Between Cassiopeiae and Ursa Major, on the opposite side of Cepheus, is a long, straggling line of faint stars, marking Camelopardalis, the Giraffe.

Bootes (The Bear-Driver.)

If we draw a line through the rim of the Big Dipper and extend it in an easterly direction about three and one half times the distance between the stars in the rim of the dipper, a brilliantly beautiful red star will be seen, the brightest in all that part of the heavens. This is Arcturus, which marks the left knee of Böotes the Bear-Driver. This constellation can be easily found; for Arcturus is in what appears to be the tail of a five sided kite, formed by five bright stars. These five stars represent the body of the Bear-Driver. The upper stars of the kite represent his shoulders; his left arm is raised and in his left hand he holds the leashes of the two Hunting Dogs, which are chasing the Great Bear around the Pole. These dogs are represented by two stars and are found by drawing a line to Arcturus through the two stars in the bottom of the Dipper bowl. The Hunting Dogs are about midway on this line. Just below Arcturus there are three comparatively bright

stars, one of which marks his right knee, and the other two mark the left leg below the knee. The Bear-Driver faces the east, thus looking toward the beautiful northern crown which lies just beyond his right shoulder.

Corona Borealis (The Northern Crown.)

To the northeast of Arcturus will be seen a semi-circle of six bright stars bearing the name of the Northern Crown or Corona Borealis. Of this brilliant little group of stars a very interesting legend is told. It was supposed to be the Crown of Ariadne presented to her by Bacchus to console her for the desertion of the faithless Theseus; and after her death the crown was placed among the stars. This constellation on the whole is a bright one. It consists of seven principal stars, six forming the crown proper, and the seventh is in the line with the last two stars on the side next to Arcturus. The stars are of the white twinkling kind and the entire constellation extends through a distance equal to about three times the distance between the pointers. The stars being so brilliant and so near Arcturus and thus forming such a complete semi-circle—the constellation is a prominent one and not difficult to locate.

Hercules.

Directly east of Corona Borealis is found the constellation Hercules. The most interesting feature of this constellation is the beautiful star cluster that is found in it. The cluster lies just beyond the naked eye vision, but the telescope reveals a mass of stars several thousand in number, one of the finest objects in the sky. The bright stars of the constellation outline a rather large reversed K, which is easily recognized.

Lyra (The Harp.)

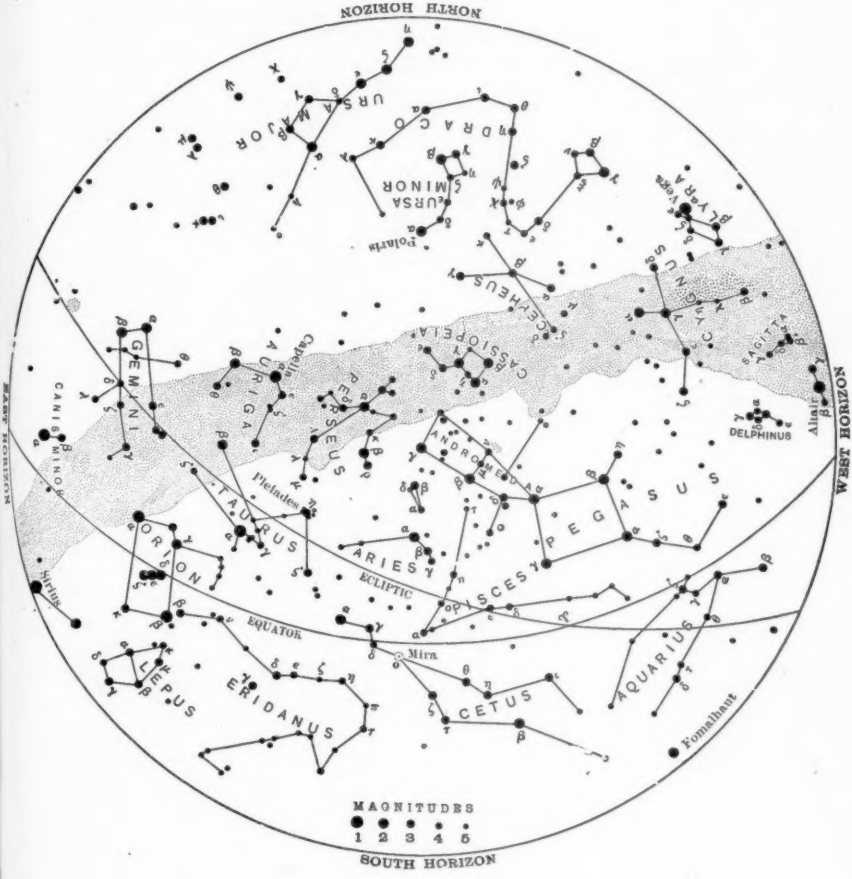
Just east of Hercules lies the constellation Lyra, the Harp. This is a small constellation, marked by the brilliant star Vega and half a dozen small stars which can be imagined to form the outline of a harp. Vega is the most striking feature of the constellation. It has a bluish tinge and is the most brilliant star in the sky, except Sirius. Vega is a large sun. It gives out ninety times more light than our sun and it takes twenty-nine years for light to travel from it to us. It is believed that our sun and all his planets are travelling toward Vega.

This star was known to the Persians as the lyre, but the Britons called it King Arthur's harp.

To be continued.

PLANET NOTES FOR DECEMBER, 1914.

The sun will move from 21° 43′ south to its farthest point south and return to 28° 4′ south by the end of the month. It will be at its farthest point south on December 22, and on this date is said to enter Capricornus, which marks the beginning of winter.



THE CONSTELLATIONS AT 9:00 P. M. DECEMBER 1.

The phases of the moon for the month are as follows:

Full Moon	Dec.	2	at	12 M.	C. S. T.
Last Quarter		10	"	5 A.M.	"
New Moon		16	"	9 P.M.	"
First Quarter		24	"	2 A.M.	"

Mercury will be moving from its position of greatest elongation west, which it reached on November 23, toward the sun throughout the month. By the end of the month it will be rather close to the sun. It will not be visible at any time during December.

Venus, having passed the sun on November 27, will continue to move westward until the middle of the month, after which it will begin a slow eastward motion. Early in the month it will be visible on the eastern horizon at sunrise, and later in the month will be conspicuous as the morning star.

Mars will continue to be invisible throughout the month because of its nearness to the sun. It will be within a few degrees of the sun the entire month, moving eastward a little more slowly than the sun. The sun will pass it during the latter part of the month.

Jupiter will be visible in the southwest at sunset. Its position will be becoming less favorable for observation. At the end of the month it will set about three hours after the sun.

Saturn will be coming into good position because of its retrograde motion. It will rise shortly after sunset at the beginning of the month and on December 20 will rise at sunset. It will rise earlier on each succeeding night. It will be quite far north and will be in splendid position for northern observers.

Uranus will be rather near the sun. It may be visible in the south west at sunset at the beginning of the month. At the close of the month it will be only two hours from the sun.

Neptune will rise soon after sunset, and will be in good position for observation about midnight throughout the month.

Occultations Visible at Washington.

Date 1914		Star's Name	Magnitude	IMMERSION. Washington M.T.		Angle f'm N.	EMERSION. Washington M.T.		Angle f'm N.	Duration	
				h	m	°	h	m	°	h	m
Dec.	3	136 Tauri	4.6	10	42	102	12	6	250	1	25
	3	415 B Tauri	6.1	15	44	88	16	57	297	1	13
	4	39 Geminorum	6.2	17	4	107	18	14	293	1	10
	4	40 Geminorum	6.3	17	34	130	18	38	269	1	4
	5	176 B Gemin.	6.3	8	4	90	9	3	279	0	59
	5	181 B Gemin.	6.0	8	32	118	9	29	252	0	57
	5	κ Geminorum	3.7	11	22	37	11	57	344	0	36
	6	39 Cancri	6.5	13	28	176	14	4	229	0	37
	6	40 Cancri	6.5	13	47	197	13	56	209	0	9
	7	11 Leonis	6.5	18	5	125	19	19	307	1	14
	8	44 Leonis	5.9	17	1	180	17	52	258	0	51
	9	75 Leonis	5.4	19	4	147	20	16	293	1	13
	12	85 Virginis	6.1	14	32	97	15	23	324	0	51
	23	21 Piscium	5.6	5	40	40	7	3	236	1	24
	28	18 Tauri	5.6	9	18	80	10	50	245	1	32
	30	107 B Aurigae	6.5	10	41	112	12	7	249	1	26

VARIABLE STARS.

Approximate Magnitudes of Variable Stars of Long Period on Oct. 1, 1914.

[Communicated by the Director of Harvard College Observatory, Cambridge, Mass.]

Name.	R. A. 1900.	Decl. 1900.	Magn.	Name.	R.A. 1900	Decl. 1900	Magn.
	h m	° ′			h m	° ′	
X Androm.	0 10.8	+46 27	13.0*d*	S Urs. Min.	15 33.4	+78 58	8.7
T Androm.	17.2	+26 26	<13.0	X Cor. Bor.	45.2	+36 35	12.8
T Cassiop.	17.8	+55 14	8.0 *i*	R Serpentis	46.1	+15 26	12.4
R Androm.	18.8	+38 1	12.8*d*	V Cor. Bor.	46.0	+39 52	11.0
S Ceti	19.0	− 9 53	12.4	R Herculis	16 1.7	+18 38	13.2
U Cassiop.	40.8	+47 43	12.9	U Serpentis	2.5	+10 12	10.4 *i*
V Androm.	44.6	+35 6	12.8*d*	RU Herculis	6.0	+25 20	<13.0
RR Androm.	45.9	+33 50	11.4 *i*	W Cor. Bor.	11.8	+38 3	9.8*d*
W Cassiop.	49.0	+58 1	11.9*d*	U Herculis	21.4	+19 7	11.7
U Androm.	1 9.8	+40 11	<13.0	SS Herculis	28.0	+ 7 3	9.3*d*
RZ Persei	23.6	+50 20	11.1*d*	W Herculis	31.7	+37 32	7.8
R Piscium	25.5	+ 2 22	11.6*d*	R Urs. Min.	31.3	+72 28	9.4
Y Androm.	33.7	+38 50	10.5*d*	R Draconis	32.4	+66 58	10.9 *i*
X Cassiop.	49.8	+58 46	10.4	RR Ophiuchi	43.2	−19 17	11.6*d*
U Persei	53.0	+54 20	10.8	S Herculis	47.4	+15 7	9.3*d*
R Arietis	2 10.4	+24 35	8.0	RV Herculis	56.8	+31 22	14.1
o Ceti	14.3	− 3 26	8.8	R Ophiuchi	17 2.0	−15 58	8.2*d*
S Persei	15.7	+58 8	12.0	RT Herculis	6.8	+27 11	9.8*d*
U Ceti	28.9	−13 35	11.0	Z Ophiuchi	14.5	+ 1 37	10.5*d*
R Trianguli	31.0	+33 50	6.8	RS Herculis	17.5	+23 1	9.4*d*
W Persei	43.2	+56 34	10.0	RU Ophiuchi	28.5	+ 9 30	9.5
Y Persei	3 20.9	+43 50	10.2	RT Ophiuchi	51.8	+11 11	<13.0
R Persei	23.7	+35 20	9.0	T Draconis	54.8	+58 14	9.9
V Eridani	59.8	−16 0	9.0	RY Herculis	55.4	+19 29	9.8 *i*
R Tauri	4 22.8	+ 9 56	10.6	T Herculis	18 5.3	+31 0	8.3 *i*
W Tauri	22.2	+15 49	9.6	W Draconis	5.4	+65 56	11.4*d*
T Camelop.	30.4	+65 57	12.6	W Lyrae	11.5	+36 38	11.9*d*
X Camelop.	32.6	+74 56	8.8*d*	SV Herculis	22.3	+24 58	12.8
R Leporis	55.0	−14 57	6.8	T Serpentis	23.9	+ 6 14	12.5
R Aurigae	5 9.2	+53 28	12.5	X Ophiuchi	33.6	+ 8 44	7.0
W Aurigae	20.1	+36 49	11.6	R Scuti	42.2	− 5 49	5.6
U Orionis	49.9	+20 10	8.8*d*	RW Lyrae	42.1	+43 32	13.6
V Camelop.	49.4	+74 30	11.8	R Aquilae	19 1.6	+ 8 5	7.4 *i*
X Aurigae	6 4.4	+50 15	10.2*d*	V Lyra	5.2	+29 30	<13.0
S Can. Min.	7 27.3	+ 8 32	10.2 *i*	R Sagittarii	10.8	−19 29	12 5
U Can. Min.	35.9	+ 8 37	10.6*d*	RY Sagittarii	10.0	−33 42	7.4
R Urs. Maj.	10 37.6	+69 18	12.4*d*	U Lyrae	16.6	+37 42	11.7
T Urs. Maj.	12 31.8	+60 2	12.8	TY Cygni	29.8	+28 6	<13.0
RS Urs. Maj.	34.4	+59 2	12.6*d*	RT Aquilae	33.3	+11 30	9.8*d*
S Urs. Maj.	39.6	+61 38	8.0	R Cygni	34.1	+49 58	12.6*d*
T Urs. Min.	13 32.6	+73 56	11.5 *i*	RT Cygni	40.8	+48 32	7.6 *i*
R Can. Ven.	44.6	+40 2	12.1	TU Cygni	43.3	+48 49	10.3*d*
U Urs. Min.	14 15.1	+67 15	11.0 *i*	X Aquilae	46.5	+ 4 13	12.6
S Bootis	19.5	+54 16	11.0 *i*	χ Cygni	46.7	+32 40	7.6 *i*
RS Virginis	22.3	+ 5 8	10.7	Z Cygni	58.6	+49 46	11.5*d*
V Bootis	25.7	+39 18	10.0*d*	AY Aquilae	20 2.3	+12 39	<12.0
R Camelop.	25.1	+84 17	8.7 *i*	S Cygni	3.4	+57 42	<13.0
R Bootis	32.8	+27 10	8.3*d*	S Aquilae	7.0	+15 19	9.6
U Bootis	49.7	+18 6	11.2	RU Aquilae	8.0	+12 42	<13.0
Y Librae	15 6.4	− 5 38	10.4*d*	Z Aquilae	9.8	− 6 27	<13.0
S Cor. Bor.	17.3	+31 44	12.3*d*	R Delphini	10.1	+ 8 47	8.6*d*
RU Librae	27.7	−14 59	9.3*d*	RT Sagittari	11.1	−39 25	8.4*d*

Approximate Magnitudes of Variable Stars of Long Period on Oct. 1, 1914.—Continued.

Name.	R. A. 1900.	Decl. 1900.	Magn.	Name.	R.A. 1900.	Dec. 1900.	Magn.
	h m	° ′			h m	° ′	
U Cygni	20 16.5	+47 35	6.6	RU Cygni	21 37.3	+53 52	8.5
Z Delphini	28.1	+17 7	9.2	RR Pegasi	40.0	+24 33	13.5
ST Cygni	29.9	+54 38	11.8	Y Pegasi	22 6.8	+13 52	9.0
V Cygni	38.1	+47 47	8.8	S Aquarii	51.8	−20 53	<13.0
T Aquarii	44.7	− 5 31	9.0*d*	R Pegasi	23 1.6	+10 0	10.2
RZ Cygni	48.5	+46 59	<10.0	V Cassiop.	7.4	+59 8	10.6*d*
X Delphini	50.3	+17 16	11.4	W Pegasi	14.8	+25 44	10.7*d*
R Vulpeculae	59.9	+23 26	10.0	S Pegasi	15.5	+ 8 22	9.8*d*
RS Capricorni	21 1.7	−16 49	8.1	ST Androm.	33.8	+35 13	9.0
TW Cygni	1.8	+29 0	10.5	R Aquarii	38.6	−15 50	7.2*d*
T Cephei	8.2	+68 5	6.6 *i*	Z Cassiop.	39.7	+56 2	<13.0
X Pegasi	16.3	+14 2	13.0	Z Pegasi	55.0	+25 21	12.4
T Capricorni	16.5	−15 35	9.6	SV Androm.	59.2	+39 33	8.0
S Cephei	36.5	+78 10	9.0				

The letter *i* denotes that the light is increasing; the letter *d*, that the light is decreasing; the sign < that the variable is fainter than the appended magnitude.

The above magnitudes have been compiled at the Harvard College Observatory from observations made by the following observers:—H. C. Bancroft, Jr., T. C. H. Bouton, A. B. Burbeck, A. P. C. Craig, S. C. Hunter, S.H. Huntington, M.W. Jacobs, Jr., J. B. Lacchini, F. C. Leonard, O. Mach, C. Y. McAteer, W. T. Olcott, H. M. Swartz, H. W. Vrooman, A. S. Young, C. Richter, H. O. Eaton, H. L. Baldwin, C. B. Lindsley, F. H. Spinney, C. S. Mundt, D. B. Pickering, D. M. Brunswick, F. H. Hay.

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes and May E. Abbott at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5^h; Central standard time 6^h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1914 December.
	h m	° ′		d h	d h; d h; d h; d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.4	36 13.7	4 16;
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	8 16; 16 19; 24 23
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	6 9; 14 3; 21 21; 29 15
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	14 7; 29 2
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	5 10; 13 8; 21 7; 29 6
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	4 23; 12 18; 20 13; 28 8
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	5 11; 12 18; 20 0; 27 7
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	14 30
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	4 1; 12 15; 21 5; 29 19
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	1 5; 12 8; 23 11
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	11 1; 22 16
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	5 11; 13 3; 20 19; 28 11
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3	2 0; 12 4; 22 7
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	2 5; 9 22; 17 16; 24 9
RZ Gemin.	5 56.6	+22 12	9.1—10.0	5 12.7	2 1; 7 14; 18 15; 19 17
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	1 22; 9 12; 17 2; 24 15
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	25 13
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	2 8; 9 13; 16 18; 23 23
W Gemin.	6 29.2	+15 24	6.7— 7.5	7 22.0	2 22; 10 20; 18 18; 26 16
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	2 12; 12 16; 22 19
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	3 13; 25 20

Maxima of Variable Stars of Short Period.—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1914. December.
	h m	° ′		d h	d h d h d h d h d h
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	3 8; 11 7; 19 6; 27 5
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	2 22; 9 14; 16 7; 22 24
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	2 5; 11 12; 20 18; 30 1
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	9 13; 18 6; 27 0
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 0.0	13
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	3 10; 10 5; 17 0; 23 18
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	2 19; 9 10; 22 15; 29 5
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	8 17; 18 9; 28 1
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	4 6; 2 5; 20 4; 28 3
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	7 16; 14 10; 21 3; 27 20
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	6 15; 12 11; 18 7; 24 2
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	4 21; 9 14; 18 23; 28 8
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5	13 6; 30 12
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	3 5; 11 10; 19 14; 27 19
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	6 5; 13 5; 20 5; 27 6
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	8 0; 16 5; 24 10
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	3 0; 8 12; 19 12; 30 12
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	2 12; 10 1; 17 14; 25 3
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	8 2; 15 12; 22 22; 30 8
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	4 17; 11 12; 18 6; 25 1
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	6 22; 13 6; 19 14; 25 21
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	4 8; 14 2; 23 20
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	5 10; 14 6; 23 3
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	2 22; 8 23; 15 0; 21 2
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	1 3; 8 3; 15 3, 24 4
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	6 7; 23 10
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	1 22; 9 12; 17 3; 24 17
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	2 2; 7 20; 19 9; 30 23
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	5 12; 12 6; 19 0; 25 18
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	9 18; 20 2; 30 11
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	4 12; 10 12; 16 13; 22 14
RZ Lyrae	39.9	+32 42	9.9—11.2	0 12.3	1 18; 7 21; 14 0; 20 4
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	3 23; 9 22; 15 21; 21 19
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	8 6; 17 8; 26 10
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	7 9; 14 9; 21 10; 28 10
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	2 9; 9 9; 16 9; 23 9
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	5 14; 13 13; 21 13; 29 12
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4 4; 11 21; 19 13; 27 6
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	8 1; 15 5; 22 9; 29 13
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	1 10; 9 19; 18 4; 26 14
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	4 22; 11 6; 17 14; 23 21
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	13 17; 30 3
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	5 4; 14 1; 22 21; 31 18
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	2 1; 8 18; 15 12; 22 5
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	2 9; 9 2; 15 19; 22 12
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	7 2; 21 19
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	6 11; 14 8; 22 5; 30 1
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	4 19; 11 16; 18 13; 25 11
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	4 6; 9 2; 18 20; 28 13
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	3 13; 12 4; 20 20; 29 11
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	3 13; 8 22; 19 15; 30 9
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	10 9; 21 6
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	1 14; 8 0; 14 11; 20 21
V Lacertae	22 44.5	+55 48	8.2— 8.9	4 23.6	1 13; 6 13; 16 12; 26 11
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	2 9; 7 19; 18 16; 29 13
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	1 9; 7 16; 13 23; 20 6
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	8 7; 20 10
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	5 18; 10 17; 20 17; 30 16

Minima of Variable Stars of Short Period.

[Calculated by May E. Abbott, at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5h; Central Standard 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1914 December.							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8			17 8					
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	6 19;	14 11;	22 3;	29 29				
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	6 19;	14 5;	21 15;	29 2				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	7 9;	14 21;	22 8;	29 20				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	5 3;	11 6;	17 9;	23 11				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	2 6;	9 9;	16 13;	23 16				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	7 20;	14 17;	21 13;	28 10				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	3 6;	10 10;	17 14;	24 18				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	8 2;	16 20;	25 15					
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	6 21;	14 20;	22 18;	30 17				
RX Cassiop.	58.8	+67 11	8.6— 9.1	32 07.6			17 4					
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	2 10;	8 4;	19 15;	31 2				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4 23;	11 18;	18 13;	25 8				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	4 2;	11 23;	19 21;	27 19				
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	7 0;	15 8;	23 15;	31 23				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	1 20;	9 18;	17 15;	25 13				
RW Persei	13.3	+42 04	8.8—11.0	15 04.8		13 2;	26 6					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	7 15;	17 2;	26 12					
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	2 1;	14 11;	26 21					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	4 22;	11 14;	18 6;	24 22				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	6 9;	11 20;	17 7;	22 18				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	6 0;	12 0;	18 0;	24 1				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	1 21;	10 13;	19 5;	27 21				
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	4 10;	14 20;	25 5					
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	6 15;	14 15;	22 16;	30 16				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	4 20;	10 14;	16 8;	22 1				
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	5 15;	11 5;	16 19;	22 10				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	5 0;	13 5;	21 10;	29 15				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	4 3;	11 18;	19 9;	27 0				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	5 17;	17 22;	30 3					
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	1 19;	8 23;	16 3;	23 7				
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	7 9;	16 11;	25 13					
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	3 16;	12 23;	22 6;	31 13				
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	4 9;	14 7;	24 5					
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	3 0;	11 10;	19 20;	28 5				
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	1 4;	7 15;	14 1;	20 11				
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	1 5;	8 12;	15 18;	23 1				
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	2 12;	10 14;	18 17;	26 20				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	5 12;	14 23;	24 11					
RX Hydrae	9 0.8	− 7 52	9.1—10.5	2 6.8	5 1;	14 5;	23 8					
S Antliae	27.9	−28 11	6.3— 6.8	0 07.8	6 2;	12 14;	18 1;	25 13				
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	1 4;	7 3;	19 0;	30 20				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	7 4;	15 11;	24 1					
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	6 7;	15 13;	24 20					
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	4 13;	11 3;	17 18;	24 8				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	6 0;	14 19;	23 14					
RW Urs. Maj.	35.4	−52 34	10.3—11.4	7 07.9	8 1;	15 9;	22 16;	30 0				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	5 6;	12 1;	18 20;	25 15				
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	4 13;	12 1;	19 13;	27 1				
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	8 9;	15 20;	23 6;	30 16				
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	4 11;	11 10;	18 10;	25 10				
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	2 11;	9 9;	16 7;	23 4				
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.4	5 12;	13 22;	22 9;	30 19				
SS Librae	15 43.4	−15 14	9.3—11.5	0 18.4	6 15;	14 7;	21 23;	29 15				

Minima of Variable Stars of Short Period.—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1914 December.
	h m	° ′		d h	d h d h d h d h
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	8 4; 15 12; 22 20; 29 4
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	8 0; 16 6; 24 13
R Arae	31.1	−56 48	6.8— 7.9	4 10.2	1 4; 10 1; 18 21; 27 17
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	10 17; 21 18; 31 11
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	1 7; 8 2; 14 22; 21 17
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	1 22; 10 7; 18 17; 27 2
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	5 8; 11 11; 17 15; 23 19
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	7 4; 14 9; 21 14; 28 19
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	1 22; 9 7; 16 16; 24 1
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	8 0; 16 4; 24 9
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	2 14; 10 3; 17 16; 25 5
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	7 7; 15 1; 22 19; 30 13
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	1 23; 9 23; 17 22; 25 22
WX Sagittae	53.6	—17 24	9.2—10.8	2 03.1	8 18; 17 6; 25 18
WY Sagittae	17 54.9	—23 1	9.5—10.6	4 16.0	4 1; 13 10; 22 18
SX Draconis	18 03.0	+ 58 23	9.3—10.5	5 04.1	4 23; 15 7; 25 15
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	5 22; 13 4; 20 10; 27 16
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	6 15; 13 13; 20 11; 27 8
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2	4 16; 19 19
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	8 14; 16 20; 25 2
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	4 10; 13 7; 22 5; 31 2
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	6 22; 15 5; 23 13; 31 20
RR Draconis	40.8	+62 34	9.3—13	2 19.9	7 22; 16 10; 24 22
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	6 6; 12 22; 19 13 26 5
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	2 16; 15 14; 28 12
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	7 6; 16 19; 26 8
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	5 19; 13 9; 20 23; 28 12
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	6 16; 13 21; 21 2; 28 6
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	5 1; 14 0; 22 22; 31 21
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	6 20; 13 14; 20 8; 27 3
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	8 3; 15 11; 22 20; 30 5
TT Lyrae	24.3	+41 30	9.3—11.6	5 05.8	5 11; 10 17; 21 4; 31 16
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	2 14; 9 3; 15 16; 22 4
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	3 22; 9 22; 15 22; 21 22
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	4 13; 11 4; 17 19; 24 11
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	8 18; 17 22; 27 1
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	4 1; 12 11; 20 22; 29 8
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	4 8; 11 3; 17 22; 24 17
UW Cygni	19.6	+42 55	10.5—13	3 10.8	6 11; 13 9; 20 7; 27 4
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	25 17
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	4 8; 13 23; 23 14
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	6 20; 16 1; 25 6
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	7 18; 15 5; 22 17; 30 5
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	4 10; 10 6; 16 3; 21 23
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	2 3; 12 5; 22 7
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	1 9; 8 19; 16 4; 23 13
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	5 20; 15 13 25 6
RY Aquarii	14.8	—11 14	8.8—10.4	1 23.2	5 4; 13 1; 20 22 28 19
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	3 16
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	2 11; 12 14; 22 18
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	5 2; 10 7; 20 15; 31 0
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.6	4 11; 9 21; 20 19; 31 16
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.3	8 14; 16 21; 25 4
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	1 1; 8 14; 16 3; 23 16
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	8 22; 17 4; 25 10

New Variable Stars.—In *A. N.* 4746 a long list of newly discovered variable stars is given. These new variables are reported by Mr. C. O. Lampland who, together with Mr. E. C. Slipher, found them in an examination of a large number of negatives at the Lowell Observatory, Flagstaff, Arizona. There are forty-eight in the list, scattered through the constellations Libra, Lupus and Scorpio. They are all quite faint, in fact out of reach visually for any but the largest telescopes.

A star which varies between magnitude 10 and magnitude 13, probably of long period, is announced by W. Ceraski in *A. N.* 4751. It was discovered by Mme. L. Ceraski in the constellation Camelopardalis. Its approximate position for 1900.0 is $\alpha = 6^h\ 25^m.3$, $\delta = +\ 73^\circ\ 59'$.

COMET AND ASTEROID NOTES.

Comet 1913 *f* (Delavan).—In this number of POPULAR ASTRONOMY will be found brief articles on this comet by Professor E. E. Barnard of the Yerkes Observatory and by Mr. Lewis L. Mellor of the Detroit Observatory. Both are illustrated with fine photographs showing the two tails of the comet.

The comet has lived up to the predictions made concerning its brightness and it has been an easy naked-eye object toward the northwest, an hour to two hours after sunset. Its course during November will carry it down nearer to the sun, with which it will be in conjunction in right ascension on November 10. At that time it will be about thirty-two degrees north of the sun, so that it can still be observed both in the evening and the morning. Later it will become a morning object only. Its course among the stars is almost exactly southeast, from Böotes into Serpens. On November 24, 25 and 26 it will be near α Serpentis. The calculated brightness of the comet will wane to about half its maximum by the end of the month. For an ephemeris see the October number of POPULAR ASTRONOMY.

Comet 1914 *e* (Campbell).—The bright comet discovered in the constellation Dorado came rapidly north and west-ward and was above our horizon by the first of October, but probably most observers, lacking an ephemeris, failed to catch sight of it before the moonlight became so strong that the comet was invisible. When the moon had passed out of range the comet had lost so much of its brilliancy that it was no longer visible to the naked eye.

Professor Clarence T. Hagerty of the New Mexico College of Agriculture and Mechanic Arts, East Las Cruces, N. M., had the good fortune to independently discover this comet on the night of September 25, a week after the discovery at Arequipa, Peru. His letter giving observations on several dates is given below.

At Goodsell Observatory the comet was not picked up until October 8 when it was too faint to be seen with the naked eye and was not even very conspicuous in the telescope, although it was at once seen when it entered the field of the five-inch finder. The following are all the accurate positions that have come to hand at the date of this writing (Oct. 26).

Greenwich Mean time	R.A. h m s	Decl. ° ′ ″	Observer	Place
Sept. 27.8070	23 32 33.1	—38 04 24	Miss Glancy	Cordoba
29.4948	23 10 09.1	—32 35 40	Miss Glancy	Cordoba
Oct. 8.5950	22 11 37.7	—12 26 40	Wilson	Northfield
13.6435	21 58 50.2	— 6 24 12	Wilson	Northfield
15.5798	21 55 15.4	— 4 54 11	Wilson	Northfield
24.5541	21 47 24.7	+ 1 06 41	Wilson	Northfield

The Harvard College Observatory Bulletin 567, issued October 3, gives the following preliminary elements and ephemeris computed by Miss Levy and C. D. Shane, of the Berkeley Astronomical Department, from observations on September 26, 27 and 29.

Elements

T = 1914, August 4.91 Greenwich M.T.
ω = 267° 48′
Ω = 0 24
i = 77 53
q = 0.683

Ephemeris

Greenwich M. T.	R. A.	Decl.	Light
1914 October 2.5	$22^h\ 42^m\ 30^s$	—24° 14′	0.59
6.5	22 20 10	15 57	
10.5	22 06 45	10 08	
14.5	21 58 21	— 5 56	0.15

These elements are so uncertain that we have not drawn the diagram of the orbit from them, hoping that better elements might arrive in time. The course of the comet will carry it northward and westward through the southwest corner of Pegasus and the east corner of Vulpecula, into Cygnus.

The following later ephemeris comes to hand just as we go to press. It was computed by Miss Levy and C. D. Shane from observations on September 27, October 8 and 14. The elements have not yet come to hand. An observation on October 24 at Goodsell Observatory shows that the ephemeris is quite accurate.

	h	m	s	°	′	
1914 Oct. 24.5	21	47	25	+1	06	0.23
28.5		46	08	2	51	
Nov. 1.5		45	48	4	19	
5.5	21	46	10	+5	34	0.06

Independent Discovery of Comet 1914 *e* (Campbell).—On the night of September 22 at 11:30 Mountain time, I observed with the naked eye a new comet in the constellation Phoenix, and immediately reported to Harvard Observatory, which report Harvard gave to the Associated Press the following Tuesday, September 29. Since I first observed it until my last observation, October 6, it has traveled 39° or 40° northwestward to a point in Aquarius about 20° east of Jupiter. It has no tail, has been at no time a very conspicuous object, and is now quite dim to the naked eye. It was brightest the first night I saw it, because the increasing moonlight interfered afterwards. Perhaps at that time it was at perihelion also.

Although clouds and moonlight interfered considerably, I give below a record of a few observations which I made, giving Mountain standard time and approximate positions.

Date	Time	R. A.	Decl
Sept. 25	11:30	$0^h\ 5^m$	—45° 30′
" 27	10:00	23 33	—39 00
" 28	10:00	23 18	—35 39
Oct. 4	11:00	22 22	—15 45
" 6	11:00	22 18	—14 39

So far as I know at present, this comet had not been discovered previously.

CLARENCE T. HAGERTY.

State College, N. M., Oct. 8, 1914.

Encke's Comet.—From *The Observatory* for October 1914 we obtain the following elements of Encke's comet, computed by M. L. Mathewitsch, of Pulkova:

$T = 1914$ Dec. 5.0143 Berlin mean time
$\phi = 57° 56' 13''$
$\Omega = 334\ 32\ 14$
$\pi = 159\ 10\ 41$
$i = 12\ 34\ 56$
$\mu = 1076''.113$

The comet was observed at the Simeis Observatory, Crimea, on Sept. 20, $14^h\ 35^m$ local mean time, R. A. $3^h\ 50^m\ 19^s$, Decl. $+ 39° 14' 18''$, the estimated magnitude being fourteen.

The observations indicate a correction to the time of perihelion, making it Dec. 4.9495 Greenwich mean time.

The comet was well placed for observation during October, being in high north declination. It was nearest the earth Oct. 27, when the distance was 0.287 or about 27,000,000 miles. During November it will go in toward the sun rapidly and will be difficult if not impossible to observe after the middle of the month.

The following ephemeris has been computed by the editors from the elements given above with the corrected date of perihelion. It will appear from the column of magnitude that the comet will not be much brighter than a star of the eleventh magnitude. The computation is based upon the statement that on Sept. 20 the magnitude was 14.0

EPHEMERIS OF ENCKE'S COMET.

Greenwich Midnight	R.A. h m s	Decl. ° ′ ″	Mag.
Nov. 1.5	12 47 31.1	+34 22 20	10.7
5.5	13 20 40.3	+23 04 02	10.8
9.5	13 43 29.0	+13 42 35	10.8
13.5	14 00 23.5	+ 6 06 57	10.9
17.5	14 14 15.0	— 0 03 22	11.0
21.5	14 26 55.2	— 5 14 38	11.1
25.5	14 40 06.3	— 9 46 17	11.1
29.5	14 55 32.3	—13 52 40	11.1
Dec. 3.5	15 14 48.1	—17 38 29	11.2
7.5	15 38 16.5	—20 57 26	11.5

Elements of Asteroid Aguntina (744.)—These elements are based upon observations published in the Nachrichten No. 4739, page 184.

$T =$ Oct. 7.5000 $= 1914$ G.M.T.
$M = 60° 38' 3''.08$
$\omega = 71\ 0\ 12\ .78$
$\pi = 213\ 28\ 59\ .38$
$\Omega = 142\ 28\ 46\ .60$
$i = 7\ 14\ 14\ .26$
$\phi = 11\ 50\ 30\ .11$
$\log a = 0.5238814$
$\log q = 0.4241348$
$\mu = 581''.0112$

$$x = r\,[9.9987179]\ \sin(232\ 42\ 2.75'' + v)$$
$$y = r\,[9.9790657]\ \sin(144\ 6\ 12.89'' + v)$$
$$z = r\,[9.4951514]\ \sin(129\ 11\ 0.55'' + v)$$

F. E. SEAGRAVE.

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers. Sept.-Oct., 1914.

It is most fitting and most gratifying to all concerned that we should close our fiscal year with the best monthly report we have yet published in the three years of our activity.

Thanks to the diligénce and zeal of Mr. H. C. Bancroft, Jr., we have broken the individual monthly record for number of observations, and the individual annual record of estimates. Mr. Bancroft concluded his year's work with a list of 437 observations of 129 variables, a record any observer may be justly proud of. Mr. Bancroft's list included observations of a great many of the variables on the neglected list. It is a pleasure to note that all our members have endeavored to observe some of these stars, and the results are shown in the total of 177 variables observed this month, and in the total for the year of 255 variables, a good advance over the number observed last year.

In POPULAR ASTRONOMY for October, at the close of the H. C. O. report, will be found a list of faint and neglected variables. Members can render a valuable service by observing as many of these stars as possible.

Mr. Richter deserves mention for his good list of 318 estimates made during the past month, including many early-morning observations,

It is a pleasure to announce that Mr. Cassius A. Phillips, "Ph", of Elmira, N. Y. has recently joined the Association. Mr. Phillips observes with a four-inch Clark refractor.

Mr. D. M. Brunswick, "Bk", one of our new recruits, contributes his observations for the first time in this report.

Our members will learn with regret of Dr. Gray's illness. Dr. Gray as one of the charter members of our Association and ever a zealous promoter of its welfare is in a large measure responsible for the success that has marked its course. The Secretary, in expressing his best wishes for Dr. Gray's speedy recovery, voices the sentiments of all members of the Association.

The thanks of the Association are due Messrs. Lindsley and Pickering for blue prints for distribution.

A correspondent of the "English Mechanic" writes that the complete set of Professor Hagen's "Atlas Stellarum Variabilium" is now offered by Messrs. Bowes and Bowes of Cambridge, England, for forty-five shillings. This is a rare bargain which some of our members may like to avail themselves of.

The Secretary publishes a note elsewhere in this issue in regard to Mr. Leon Campbell's suggestion in POPULAR ASTRONOMY for October, relative to a systematic search for novæ. This work is extremely important and right in our line. As an organized body of observers we can render a valuable service by taking up this work. It is hoped that many will respond to the call for volunteers for this work.

The recent maximum of 213843 SS Cygni was well observed. The variable *184205* R Scuti has waxed about half a magnitude during the past month, an interesting feature in the history of this irregular variable.

The annual record of the work of the Association is published in this report. It includes the total number of observations contributed by each of our members. It also affords an interesting comparison with the work of previous years, indicating the steady growth of the Association in every particular. The fact that the total

VARIABLE STAR OBSERVATIONS Sept.-Oct. 1914.

001032
S Sculptoris
Mo. Day Est. Obs.
9 26 11.1 Ba

001046
X Androm.
9 9 12.6 Ba
12 12.7 Ba
18 12.8 Ba

001755
T Cassiop.
9 2 10.0 Bu
9 9.8 Bu
13 9.4 Bl
13 9.7 Sp
13 10.8 J
15 9.8 S
15 8.7 Ba
16 9.4 Bu
21 8.9 B
27 9.2 Bu
28 8.0 Ba
27 8.8 Pi
29 9.3 M

001838
R Androm.
9 2 11.6 Ly
9 11.5 Ly
12 11.4 Ly
18 12.5 Ly
19 12.6 Hu
21 12.5 B

001909
S Ceti
9 26 12.4 Ba

003179
Y Cephei
9 15 12.6 Hu

004047
U Cassiop.
9 21 12.8 B

004132
RW Androm.
9 14 12.6 B
19 12.8 J
21 13.0 B

004435
V Androm.
9 14 12.0 Ba
18 12.2 Ba
19 12.6 Ma
21 12.4 B

004533
RR Androm.
9 14 12.0 Ba
18 11.8 Ba
19 11.9 Ma
28 11.4 Ba

004746
RV Cassiop.
Mo. Day Est. Obs.
9 11 12.3 L
13 12.3 L
15 13.2 Ba
17 12.1 L

004958
W Cassiop.
9 9 10.7 Ba
12 11.3 O
13 11.2 Sp
13 11.3 J
14 11.2 Bl
14 10.6 Ba
15 11.8 Sp
18 11.0 Ba
19 11.7 J
19 10.3 B
22 10.9 Ba
26 11.1 Ba

011208
S Piscium
9 28 12.5 Ba

011272
S Cassiop.
9 2 10.5 Bu
9 10.2 Bu
15 13.0 Ba
16 9.8 Bu
19 12.5 B
27 9.8 Bu

012350
RZ Persei
9 14 10.7 Ba
19 10.8 Ba
28 11.0 Ba

012502
R Piscium
9 9 11.5 Ba

013238
RU Androm.
9 19 12.2 J
13 12.5 J

013338
Y Androm.
9 2 9.0 Bu
9 10.5 J
9 9.4 Bu
15 11.0 Ba
16 9.8 Bu
27 10.2 Bu

014958
X Cassiop.
9 4 10.7 B
13 11.6 L
15 11.0 Ba
19 10.1 B
20 11.3 M
21 10.5 Y
27 10.6 M
28 10.5 Ba

015254
U Persei
Mo. Day Est. Obs.
9 4 11.0 Ly
13 10.8 Pi
15 11.0 Ba
20 10.9 M
21 11.0 Bl
26 11.0 Pi
27 10.7 M
28 10.8 Ba

021024
R Arietis
9 9 7.5 Bl
12 8.2 Pi
15 8.0 Ba
19 8.5 S
21 8.6 M
26 8.2 Pi
28 7.9 Ba

021403
o Ceti
8 24 8.7 L
9 9 8.5 Bl
11 8.6 C
14 8.8 Bl
15 8.9 L
18 9.0 R
21 9.0 Bl
27 8.8 M
28 8.8 Ba
10 1 9.1 Le

021658
S Persei
9 2 11.6 Ly
9 11.4 Ly
12 11.4 Ly
13 12.4 Sp
15 12.5 Sp
15 12.3 Ba
18 12.1 B
21 12.4 Sp
28 12.0 Ba

022000
R Ceti
9 27 9.1 M

022150
RR Persei
9 21 10.7 Y

022813
U Ceti
8 24 9.0 L
9 14 10.7 Bl
11 10.5 Bl
26 11.0 Ba

023133
R Triang.
9 15 6.7 Ba
22 6.8 Ba
28 6.8 Ba
10 1 6.3 Le

024356
W Persei
Mo. Day Est. Obs.
8 25 9.5 L
9 2 9.5 Ly
5 10.0 Bl
9 9.4 Ly
12 9.4 Ly
13 9.4 L
13 10.2 Bl
14 8.5 M
15 9.2 Ba
17 10.2 Bl
18 10.0 Ly
18 9.5 R
19 9.5 R
20 9.6 M
21 10.4 Bl
22 9.5 Ba
23 9.6 R
26 10.0 Pi
27 10.0 M
28 9.3 Ba
10 1 10.2 Le

032043
Y Persei
9 4 10.1 Ly
12 9.9 Ly
13 10.5 Bl
15 10.3 M
15 10.0 Ba
18 10.1 Ly
20 10.2 M
21 10.8 Bl
22 10.3 Ba
26 9.9 B
28 10.0 Ba

032335
R Persei
9 15 8.5 Ba
19 9.3 S
20 8.7 M
21 9.8 Y
28 9.0 Ba

033362
U Camelop.
9 4 8.1 Ly
6 8.0 Ly
8 8.0 Ly
15 7.3 Ba
20 8.4 M
28 7.2 Ba
10 1 7.1 Le

035915
V Eridani
9 14 8.9 Bl
21 8.9 Bl
26 9.0 Ba

042209
R Tauri
Mo. Day Est. Obs.
9 26 10.5 Ba
27 10.0 M

042215
W Tauri
9 12 9.1 Ba
13 8.5 Bl
14 9.6 M
19 9.4 Ba
21 8.5 Bl
26 9.5 Ba
26 9.5 Pi
26 9.6 M
27 9.0 M

042309
S Tauri
9 27 11.6 M

043065
T Camelop.
9 19 12.5 Ba

043274
X Camelop.
8 23 8.3 L
26 8.3 L
9 2 8.0 Ly
12 8.2 L
15 8.3 Bl
16 8.1 O
19 8.1 Ba
19 8.1 O
21 8.4 Sp
26 8.7 O
10 8 9.0 O
9 9.5 O

045514
R Leporis
8 24 7.0 L
9 15 6.8 L

050953
R Aurigae
9 19 12.7 Ba
28 12.5 Ba

052034
S Aurigæ
8 24 9.9 L
9 15 9.8 L
16 9.5 M
18 9.4 M
21 9.3 M
27 10.0 M
28 8.5 Ba

052036
W Aurigae
9 19 12.5 Ba
27 11.6 Ba

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

054920
U Orionis

Mo	Day	Est.	Obs.
8	24	8.6	L
9	15	8.8	Pi
	15	8.7	L
	19	8.7	Ba
	19	8.7	M
	27	8.5	M

054974
V Camelop.

9	12	11.4	Ba
	15	11.3	Ba
	19	11.5	Ba
	21	11.2	Bl
	22	11.4	Ba
	27	11.7	Ba

060450
X Aurigae

8	24	8.5	L
9	13	9.8	L
	19	10.1	Ba

063159
U Lyncis

9	27	13.0	Ba

064030
X Gemin.

9	15	11.2	L

065208
X Monoc.

9	15	8.2	L

070122
R Gemin.

9	27	8.0	M

070310
R Can. Min.

8	26	8.4	L
9	15	8.3	L

072708
S Can. Min.

9	1	10.2	Ly
	16	10.3	Ly
	19	10.6	M
	27	10.1	M
	30	9.9	M

073508
U Can. Min.

8	26	9.5	L
9	15	10.3	L
	21	10.5	Bl

074922
U Gemin.

9	15	10.9	L

094211
R Leonis

9	21	9.2	Bl

103769
R Urs. Maj.

Mo	Day	Est.	Obs.
8	24	11.7	L
9	2	11.3	Ly
	8	12.0	Ba
	9	12.0	J
	11	11.8	H
	12	12.0	Ba
	15	11.8	B
	16	12.2	Ba
	18	11.6	Ly

123160
T Urs. Maj.

9	8	12.8	Ba
	22	12.7	B

123307
R Virginis

9	4	11.1	Ly

123459
RS Urs. Maj.

9	8	11.3	Ba
	16	12.4	Ba

123961
S Urs. Maj.

8	23	9.3	L
	28	9.0	L
9	2	8.8	Bu
	2	8.7	Ly
	3	8.4	M
	4	8.5	B
	4	8.8	Bl
	7	8.4	Ba
	8	8.6	Ma
	8	8.7	E
	9	8.5	C
	9	8.4	Bu
	9	9.2	J
	9	8.6	Ly
	11	8.4	C
	12	8.4	Ba
	12	8.5	L
	12	8.7	Ma
	12	8.5	Pi
	13	8.7	Ly
	13	8.5	Bl
	13	8.3	C
	14	8.6	M
	14	8.3	C
	15	8.4	Ma
	15	8.4	Ba
	15	8.6	C
	16	8.5	Bg
	16	8.4	Bu
	18	8.5	S
	18	8.5	Ly
	19	8.8	Bl
	19	8.9	J
	22	8.2	Ba
	22	8.2	B

S Urs. Maj.

Mo	Day	Est.	Obs.
9	24	8.0	M
	25	8.3	Ma
	26	8.2	Ba
	27	8.0	Bu
	28	8.5	Bl
	28	8.4	M
	29	8.3	B
	30	8.0	Ba
10	1	8.5	Le

124606
U Virginis

9	2	7.9	Ly

133273
T Urs. Min.

9	8	12.2	Ba
	12	12.1	Ba
	16	12.0	Ba
	22	11.8	Ba
	26	11.7	Ba
	30	11.5	Ba

134440
R Can. Ven.

8	24	10.8	L
9	3	11.0	Ly
	4	11.0	B
	9	11.5	Ba
	15	11.7	L
	16	11.7	Ba
	22	12.1	B
	26	11.9	Ba
	30	11.0	M

141567
U Urs. Min.

9	8	11.5	Ba
	9	11.9	J
	12	11.0	Ba
	13	10.2	Bl
	16	11.1	Ba
	22	11.7	B
	22	11.1	Ba
	26	11.1	Ba
	30	11.1	Ba

141954
S Boötis

9	2	11.6	Ly
	8	11.8	Ba
	9	11.8	Ly
	11	11.5	H
	12	11.8	Ba
	16	11.6	Ba
	19	11.3	J
	22	11.7	Ba
	25	11.5	Ba
	30	11.2	Ba

142205
RS Virginis

Mo	Day	Est.	Obs.
8	24	9.1	L
9	9	10.5	Ba

142539
V Boötis

8	23	9.0	L
	28	9.0	L
	26	8.5	R
	27	9.1	R
	30	9.1	Bk
9	2	8.8	Ba
	2	8.8	Bu
	3	9.0	M
	5	9.3	Ly
	7	8.8	R
	8	8.8	Ba
	8	9.2	Ma
	8	9.0	O
	8	9.4	M
	9	8.9	R
	11	9.4	Ly
	11	9.3	O
	12	9.5	Pi
	13	9.6	Bk
	13	9.7	Bl
	13	9.1	R
	13	9.2	Ba
	14	9.5	Ly
	14	9.7	R
	15	9.3	S
	15	9.7	R
	16	9.5	Ba
	16	9.3	Bg
	16	9.4	Bu
	17	9.6	L
	17	9.4	O
	18	10.0	R
	19	9.7	R
	22	9.6	Ba
	23	10.0	R
	24	9.5	M
	26	9.7	Ba
	27	9.8	Bu
	30	9.9	Ba
10	1	9.9	Le

142584
R Camelop.

9	2	10.7	Ba
	4	10.3	Ly
	8	10.3	Ba
	8	10.3	Le
	11	9.1	H
	12	9.8	Ba
	12	10.0	L
	13	9.9	Ly
	16	9.5	Ba
	18	9.9	Ly
	19	9.9	O

R Camelop.

Mo	Day	Est.	Obs.
9	22	9.2	Ba
	22	9.8	O
	23	9.9	H
	26	9.5	O
	26	9.0	Ba
	30	8.8	Ba
10	1	9.3	O
	1	9.0	Le
	3	9.3	O
	8	9.0	O
	9	9.0	O

143227
R Boötis

8	23	7.9	L
	28	7.6	L
	26	7.9	R
	27	7.9	R
9	1	7.7	L
	2	7.8	Ly
	2	7.4	Ba
	2	7.5	Bu
	3	7.2	M
	7	7.6	R
	8	7.5	Ba
	8	7.5	Ma
	8	7.9	O
	8	7.8	R
	9	7.4	Bu
	9	7.8	R
	9	7.6	Ly
	11	8.0	C
	12	7.5	Ba
	12	7.9	O
	13	7.8	Bl
	13	7.9	R
	14	7.9	Bg
	14	8.0	R
	15	8.0	C
	15	8.0	R
	16	7.7	Ba
	16	7.2	Bu
	17	8.1	L
	17	8.3	O
	18	7.9	Ma
	18	8.0	R
	18	8.1	S
	19	8.1	R
	19	8.0	Bl
	23	8.2	Ba
	24	8.6	M
	26	8.2	Ba
	27	7.0	Bu
	28	8.2	Bl
	29	8.7	M
	30	8.3	Ba

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

144918
U Boötis

Mo.	Day	Est.	Obs.
9	9	10.8	V
	11	11.3	B
	14	11.2	B

150605
Y Librae

8	24	9.2	L
9	13	10.1	L

151714
S Serpentis

8	23	8.4	L
9	7	9.0	L
	13	9.1	Bl

151731
S Cor. Bor.

9	3	11.9	Ly
	9	12.2	Ba
	11	11.9	H
	18	12.0	Ly
	26	11.6	B
	26	12.2	Ba

152714
RU Librae

8	24	8.3	L
8	26	8.7	R
9	7	8.9	R
	8	9.0	R
	9	9.1	R
	11	8.8	C
	13	9.1	L
	13	9.2	R
	14	9.0	R
	15	9.0	R
	18	9.0	R
	19	8.9	R

153378
S Urs. Min.

8	25	9.1	L
	30	9.5	Bk
9	2	8.8	Bu
	4	8.5	Ly
	4	8.7	B
	9	8.3	Bu
	9	8.7	Ba
	12	9.1	L
	13	8.7	Ba
	13	8.6	Sp
	13	8.6	Ly
	13	8.6	Bl
	13	9.4	Bk
	16	8.4	Bu
	17	8.5	Ly
	19	8.6	Ba
	20	8.7	Bl
	23	8.8	Ba
	26	8.5	Ba
	27	8.2	Bu
	28	8.7	Bl
	30	8.8	Ba

154428
R Cor. Bor.

Mo.	Day	Est.	Obs.
8	24	6.0	L
	28	6.1	L
9	1	5.8	J
	2	6.0	Ma
	2	6.0	Ly
	2	5.6	Ba
	3	6.2	M
	4	6.0	Bl
	5	5.9	Ly
	5	6.0	Bl
	7	6.1	L
	7	6.0	Ly
	7	5.6	Ba
	7	6.2	R
	7	6.2	Mu
	8	5.7	H
	8	6.2	Mu
	8	5.6	Ba
	8	6.0	J
	8	6.0	O
	8	6.0	Ma
	8	6.0	R
	8	6.0	Bl
	9	5.8	H
	9	5.7	C
	9	6.1	R
	9	5.6	Ba
	9	6.1	Mu
	9	6.0	Ly
	9	5.9	J
	9	5.9	Hu
	10	6.2	Mu
	10	5.8	H
	10	5.9	R
	10	5.8	Ba
	11	5.9	Ly
	11	5.7	C
	11	5.8	H
	11	6.0	L
	12	5.7	Ba
	12	6.0	Pi
	12	6.6	Bg
	12	6.0	O
	12	6.1	Ma
	12	6.2	Mu
	13	5.7	C
	13	5.8	J
	13	6.2	R
	13	6.0	Bl
	13	6.0	O
	13	5.8	H
	13	5.8	Ba
	13	6.2	Mu
	13	6.0	Ly
	14	5.7	C
	14	6.5	Bg

R Cor. Bor.

Mo.	Day	Est.	Obs.
9	14	6.0	Ly
	14	6.0	Mu
	14	6.1	R
	14	5.8	Ba
	14	5.8	Bk
	15	5.6	C
	15	6.0	Pi
	15	5.9	J
	15	5.8	Ba
	15	6.1	R
	16	6.0	O
	16	5.8	Ba
	16	6.1	R
	16	5.7	Bk
	17	6.0	L
	17	6.0	O
	17	6.0	Ly
	17	5.5	J
	18	6.0	S
	18	6.0	Ly
	18	6.0	O
	18	6.2	R
	18	5.9	H
	18	5.8	Ba
	18	6.3	Mu
	19	6.0	O
	19	6.0	Bl
	19	6.3	Mu
	19	5.6	J
	19	5.8	Ba
	19	6.2	R
	20	5.5	J
	20	6.0	Bl
	20	6.2	Mu
	21	5.9	Mu
	21	5.5	J
	22	5.8	Ba
	22	5.5	J
	22	6.0	O
	23	5.8	Ba
	23	6.3	R
	23	5.7	H
	24	6.1	Ma
	24	6.3	Mu
	25	5.7	H
	26	6.0	Bl
	26	6.0	O
	26	5.9	B
	26	5.6	J
	26	5.8	Ba
	27	6.0	O
	27	5.5	J
	28	6.0	Bl
	28	6.0	O
	28	5.5	J
	28	5.8	Ba
	30	5.5	M
	30	5.8	Ba

R Cor. Bor.

Mo.	Day	Est.	Obs.
10	1	6.0	O
	1	5.7	Le
	2	6.0	O
	3	6.1	O
	5	6.0	O
	8	6.0	O
	9	6.0	O

154536
X Cor. Bor.

9	2	11.2	Ba
	8	11.6	Ba
	12	12.0	Ba
	14	11.6	J
	19	12.0	J
	26	12.7	Ba

154539
V Cor. Bor.

9	2	10.6	Bu
	2	10.8	Ly
	9	10.8	Bu
	9	10.2	Ba
	9	10.1	Ma
	11	10.6	Bk
	11	10.6	H
	13	10.2	Ba
	13	10.4	Bl
	16	11.2	Bu
	17	10.5	O
	19	10.0	Ba
	26	10.2	Ba
	27	11.2	Bu

154615
R Serpentis

8	26	10.9	R
9	2	10.8	Bu
	4	11.0	Ly
	8	11.3	E
	9	11.2	Bu
	11	11.3	H
	13	11.1	Ly
	17	12.4	B

155947
X Herculis

8	25	6.1	L
	26	5.6	R
	27	5.6	R
	28	6.1	L
9	3	6.1	L
	7	5.8	R
	8	5.8	R
	8	6.2	H
	9	5.8	R
	9	6.2	H
	10	5.9	R
	10	6.3	H
	11	6.3	H
	13	6.2	H
	13	5.9	R
	14	5.7	R

X Herculis

Mo.	Day	Est.	Obs.
9	15	6.1	R
	16	5.7	R
	17	6.3	L
	18	5.8	R
	19	5.6	R
	23	5.7	R
	23	6.3	H
	25	6.2	H

160118
R Herculis

9	9	12.6	Hu
	14	13.0	B

160210
U Serpentis

9	11	11.9	E
	11	12.3	H
	13	11.8	Ba
	16	11.4	Ba
	17	11.8	B
	26	10.7	Ba
	30	10.4	Ba

160625
RU Herculis

9	9	12.3	Hu

161138
W Cor. Bor.

9	2	7.8	Bu
	2	8.5	Ba
	8	8.5	Ba
	9	8.1	Hu
	9	8.0	Bu
	11	9.4	E
	12	8.6	Ba
	16	8.2	Bu
	16	9.1	B
	16	9.3	Ba
	17	9.5	O
	22	9.3	Ba
	24	9.7	B
	26	9.8	Ba
	27	8.4	Bu
	30	9.8	Ba

162112
V Ophiuchi

8	24	8.2	L
9	1	8.2	Bu
	4	8.2	Ly
	10	7.8	Bu
	11	8.6	C
	13	8.1	Bk
	13	8.4	Ly
	13	9.4	C
	13	8.8	L
	14	8.9	C
	15	8.9	C
	26	7.6	Bu

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

162119
U Herculis

Mo.	Day	Est.	Obs.
8	26	11.2	R
9	1	11.2	Bu
	3	11.0	Ly
	3	11.2	M
	8	10.9	E
	9	10.3	Hu
	9	11.2	Ly
	11	10.8	H
	13	11.3	Ba
	16	11.5	Bk
	17	11.5	B
	18	11.3	Ly
	19	11.2	Ba
	22	11.3	Y
	23	10.0	H
	26	11.6	Ba

162807
SS Herculis

Mo.	Day	Est.	Obs.
8	23	9.6	L
	28	9.2	L
9	2	8.7	Ba
	5	8.8	Bl
	7	8.6	Ba
	8	8.7	E
	9	8.8	Bl
	10	8.7	Ba
	11	8.7	L
	12	8.6	Ba
	13	8.8	H
	13	8.5	Bl
	16	8.6	Ba
	17	8.6	B
	17	8.7	L
	19	8.5	Bl
	22	8.8	Y
	22	8.7	Ba
	26	8.8	Ba
	28	9.2	Bl
	28	8.8	B
	30	9.2	Ba

163137
W Herculis

Mo.	Day	Est.	Obs.
9	1	9.5	Bu
	2	8.6	Ba
	3	8.4	M
	8	8.3	Ba
	9	8.0	Hu
	10	9.0	Bu
	12	7.8	Ba
	13	8.1	C
	13	8.2	M
	14	8.0	B
	14	8.0	M
	14	8.0	C
	15	7.7	S
	16	7.9	Ba
	22	7.7	Ba
	25	7.7	M

W Herculis

Mo.	Day	Est.	Obs.
9	26	8.6	Bu
	26	7.7	B
	26	7.7	Ba
	28	7.6	M
	30	7.6	Ba
10	1	7.6	Le
	8	7.8	O
	9	8.0	O

163172
R Urs. Min.

Mo.	Day	Est.	Obs.
8	26	9.8	R
9	2	9.4	Bu
	4	9.2	Ly
	4	9.1	B
	8	9.1	Ba
	8	9.2	R
	9	9.5	Bl
	9	9.1	R
	9	9.2	Bu
	11	9.3	E
	12	9.4	Bg
	13	9.2	Ba
	13	9.3	Ly
	13	9.5	R
	13	9.5	Bl
	13	9.4	H
	14	9.5	M
	14	9.4	R
	15	9.4	R
	16	9.0	Bu
	18	9.2	Ly
	18	9.2	R
	19	9.2	R
	19	9.4	Ba
	22	9.4	Ba
	23	9.4	R
	26	9.2	Bu
	26	9.1	B
	26	9.3	Ba
	29	9.6	M
	30	9.4	Ba

163266
R Draconis

Mo.	Day	Est.	Obs.
9	8	11.8	Ba
	12	11.6	Ba
	13	12.0	H
	13	11.8	Sp
	14	12.2	M
	16	11.5	Ba
	22	11.5	Ba
	26	11.0	Ba
	30	10.9	Ba

164055
S Draconis

Mo.	Day	Est.	Obs.
9	14	8.7	M
	25	8.8	M
	28	8.9	M

164319
RR Ophiuchi

Mo.	Day	Est.	Obs.
9	16	11.4	B

164715
S Herculis

Mo.	Day	Est.	Obs.
8	26	6.5	R
9	2	7.9	Ba
	2	8.2	Bu
	4	8.3	Ly
	5	8.5	Bl
	8	8.0	Ba
	8	8.4	Ma
	8	8.5	O
	8	8.6	R
	9	8.5	Bu
	9	8.5	Bl
	9	8.6	R
	9	9.0	J
	10	8.6	Bk
	11	8.5	C
	11	8.8	E
	12	8.6	Ly
	12	8.8	O
	12	8.3	Ba
	13	8.8	Bl
	13	8.8	H
	13	8.7	C
	13	8.6	Ma
	13	8.5	R
	14	8.7	C
	14	8.7	R
	15	9.0	C
	15	8.8	R
	16	8.4	Ba
	16	8.8	Bu
	17	9.2	Bk
	17	9.2	O
	17	8.6	B
	18	8.8	Ma
	18	9.0	R
	19	9.2	R
	19	9.0	Bl
	22	8.6	Ba
	23	9.2	R
	25	9.2	M
	26	9.0	Ba
	26	9.2	Bu
	28	9.3	Bl
	28	9.2	O
	28	8.9	B
	29	9.4	M
	30	9.1	Ba
10	9	9.8	O

165030
RR Scorpii

Mo.	Day	Est.	Obs.
8	26	9.7	R

165631
RV Herculis

Mo.	Day	Est.	Obs.
9	16	14.2	M
	26	14.0	M

170215
R Ophiuchi

Mo.	Day	Est.	Obs.
8	23	7.8	L
	28	7.8	L
9	2	7.5	Ba
	2	7.5	Ma
	4	7.6	Ly
	8	7.7	Ba
	8	7.7	Ma
	9	8.3	Bk
	9	7.5	Hy
	9	7.8	Bu
	9	7.9	J
	9	8.0	Bl
	11	7.6	L
	12	7.9	Ba
	13	8.3	Ma
	13	7.6	Ly
	16	8.2	Bk
	16	7.9	Ba
	16	7.4	Bu
	17	7.8	L
	19	8.2	Bl
	23	8.1	Ba
	23	8.3	H
	26	7.4	Bu
	26	8.2	Ba
	28	8.0	Bl

170627
RT Herculis

Mo.	Day	Est.	Obs.
9	2	10.2	Ba
	11	10.1	B
	12	9.8	Ba
	14	10.0	B
	16	9.5	Ba
	22	9.5	Y
	22	9.7	Ba
	26	9.7	Ba

171333
u Herculis

Mo.	Day	Est.	Obs.
8	26	5.0	R
	27	4.6	R
9	7	4.5	R
	8	4.6	R
	9	4.6	R
	10	4.4	R
	13	4.7	R
	14	4.8	R
	15	4.6	R
	16	4.7	R
	18	4.8	R
	19	4.6	R
	23	4.6	R
	24	4.8	R

171401
Z Ophiuchi

Mo.	Day	Est.	Obs.
9	5	9.5	Bl
	9	9.8	Bu
	13	9.6	Bl
	13	9.2	Ba
	16	10.2	Bu
	22	9.8	Ba
	26	10.0	Ba
	26	10.4	Bu

171723
RS Herculis

Mo.	Day	Est.	Obs.
8	23	8.4	L
	7	8.6	L
9	9	8.3	V
	10	8.5	Ba
	11	8.3	B
	14	8.4	B
	19	8.8	Ba
	19	8.5	V
	22	8.9	Y
	26	9.2	Ba
	30	9.3	Ba

172809
RU Ophiuchi

Mo.	Day	Est.	Obs.
9	5	10.9	Bl
	8	10.9	Ba
	11	10.2	E
	13	10.3	M
	13	10.5	V
	13	10.1	Ba
	15	10.3	B
	16	10.2	M
	19	10.0	Ba
	21	9.9	V
	25	9.6	M
	26	9.5	Ba

175111
RT Ophiuchi

Mo.	Day	Est.	Obs.
9	8	10.3	Ba

175458
T Draconis

Mo.	Day	Est.	Obs.
8	26	9.4	R
	27	9.3	R
9	1	9.8	Bu
	7	9.2	R
	8	9.4	R
	9	9.6	Bu
	9	9.3	R
	10	10.2	Bk
	12	10.5	V
	13	10.3	Ba
	13	9.6	R
	13	10.1	Bl
	13	9.5	Sp
	14	9.7	R
	15	9.5	R
	16	9.6	Bu
	17	9.4	B
	17	10.2	Bk

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

T Draconis

Mo.	Day	Est.	Obs.
9	18	9.6	R
	19	9.5	R
	21	10.6	V
	23	9.5	R
	23	10.7	Ba
	26	9.2	Bu
	28	10.0	M
	28	9.9	Ba

175519
RY Herculis

9	2	12.0	Ba
	11	11.5	E
	12	11.2	Ba
	14	10.9	B
	16	10.9	Ba
	17	10.7	O
	19	10.4	O
	22	10.6	Y
	22	10.5	Ba
	22	10.3	O
	23	10.4	B
	26	10.1	Ba
	26	10.2	O
	28	9.8	B
	30	9.8	Ba
10	8	9.2	O

175829
W Sagittarii

8	26	5.0	R

180531
T Herculis

8	25	10.2	L
9	1	9.4	Bu
	3	9.4	L
	4	9.1	Ly
	8	8.8	C
	8	9.0	Ma
	8	9.0	E
	9	8.5	Hu
	9	9.2	R
	9	9.0	Bl
	9	8.9	C
	10	9.0	Bu
	10	9.2	Bk
	11	9.0	H
	12	8.7	Ly
	13	9.1	R
	13	8.8	C
	13	8.9	O
	13	9.0	M
	14	8.7	Ma
	14	9.1	R
	14	8.9	C
	15	8.4	L
	15	9.1	R
	15	9.0	Pi
	16	8.7	O
	16	8.6	B
	16	8.6	Bu

T Herculis

Mo.	Day	Est.	Obs.
9	17	8.4	Bk
	17	8.6	Bl
	18	8.2	St
	18	8.2	Ly
	18	9.0	R
	19	9.1	R
	19	8.7	O
	19	8.8	S
	22	8.7	O
	23	9.0	R
	23	8.3	St
	24	8.5	B
	25	8.4	Ma
	25	8.4	M
	26	8.6	O
	27	8.4	Bu
	28	8.5	Ba
	28	8.1	Bl
	29	8.2	M
	29	8.3	St
10	1	8.4	O
	8	8.5	O

180565
W Draconis

9	2	10.4	Ba
	8	10.5	Ba
	13	10.2	Sp
	16	10.7	Ba
	22	10.9	Ba
	26	11.3	Ba

181103
RY Ophiuchi

9	8	11.4	Ba
	13	8.9	V
	15	8.9	B

181136
W Lyrae

8	26	8.7	R
	27	8.7	R
9	1	9.2	Bu
	2	9.6	Ba
	5	9.6	Bl
	7	9.5	R
	8	10.0	Ba
	8	9.6	R
	8	9.8	E
	9	9.3	Hu
	10	9.4	Bu
	12	10.4	Ba
	13	9.9	M
	13	9.9	R
	14	9.9	R
	15	10.0	R
	15	10.5	Pi
	16	10.3	O
	16	10.6	Ba
	16	9.4	Bu
	17	10.5	B
	18	10.0	R

W Lyrae

Mo.	Day	Est.	Obs.
9	19	10.2	R
	22	10.8	Ba
	23	10.2	R
	24	10.5	M
	26	11.2	B
	26	11.8	Ba
	27	9.6	Bu

182224
SV Herculis

9	14	12.8	B
	22	12.8	Y

182306
T Serpentis

9	22	12.9	Y
	28	12.6	Ba

182619
U Sagittarii

9	8	6.9	C
	9	6.8	C
	11	7.0	C
	13	7.1	C
	14	7.1	C
	15	6.9	C

183308
X Ophiuchi

8	25	7.9	L
9	1	7.8	Bu
	2	7.6	Bl
	4	7.6	Ly
	8	7.3	Ba
	8	7.5	Ma
	10	7.4	Bu
	11	7.6	Bk
	11	7.4	C
	11	9.6	L
	12	7.2	Ba
	12	7.3	Ly
	13	7.4	Bl
	13	7.4	M
	13	7.4	C
	13	7.6	Ma
	13	7.6	V
	15	7.5	C
	16	7.2	Bu
	16	7.3	Ba
	17	7.3	Bl
	18	7.5	E
	22	7.1	Ba
	25	7.6	V
	26	6.9	Ba
	27	7.3	O
	27	7.0	Bu
	28	7.0	Bl
10	9	6.8	O

184205
R Scuti

Mo.	Day	Est.	Obs.
8	23	5.7	L
	24	5.5	L
	25	5.5	L
	26	5.4	R
	27	5.4	R
9	1	5.8	Bu
	2	6.1	Ba
	2	5.8	Ma
	2	5.6	Ly
	5	6.0	Bl
	7	5.9	L
	7	6.0	Ba
	7	5.5	Ly
	7	5.9	R
	8	5.7	C
	8	5.6	R
	8	5.8	Ma
	8	5.9	Ba
	8	5.8	H
	8	6.1	O
	8	6.1	Bl
	9	5.6	R
	9	5.9	H
	9	5.4	Ly
	9	5.8	Hy
	9	6.0	Ba
	9	5.6	C
	10	6.0	Ba
	10	5.5	R
	10	5.8	H
	11	5.8	L
	11	5.8	C
	11	5.9	H
	12	5.7	Ba
	12	5.8	Bu
	12	5.5	Pi
	12	6.0	O
	12	5.8	Ma
	13	5.5	R
	13	5.7	H
	13	5.5	Ly
	13	6.0	O
	13	5.9	Hu
	13	5.8	Bl
	13	5.9	Ba
	13	5.7	C
	14	5.7	Bk
	14	5.7	C
	14	5.6	R
	14	5.8	Ba
	15	5.7	C
	15	5.7	Ma
	15	5.5	R
	15	5.6	Ba
	16	5.9	O
	16	6.0	Bu
	16	5.6	R
	16	5.5	Ba
	16	5.4	Ly
	17	5.4	L

R Scuti

Mo.	Day	Est.	Obs.
9	17	5.6	Bl
	17	5.8	O
	18	5.3	Ly
	18	5.7	H
	18	5.6	Ba
	18	5.8	O
	18	5.7	St
	19	5.7	R
	19	5.8	O
	19	5.6	Bl
	19	5.3	Bk
	19	5.3	Hy
	19	5.5	Ba
	22	5.7	Ba
	22	5.7	O
	23	5.7	St
	23	5.7	Ba
	23	5.6	R
	23	5.3	H
	24	5.6	R
	24	5.7	Ma
	25	5.2	H
	26	5.5	O
	26	5.5	Pi
	26	5.7	Bl
	26	5.7	Ba
	27	5.7	O
	27	5.8	Bu
	28	5.7	Ba
	28	5.6	O
	28	5.5	Bl
	30	5.5	Ba
10	1	5.5	O
	1	5.5	Le
	2	5.5	O
	3	5.5	O
	5	5.5	O
	8	5.5	O
	9	5.5	O

184243
RW Lyrae

9	12	13.6	Ba
	19	13.6	Ba
	26	13.6	B

184633
β Lyrae

8	26	4.1	R
	27	3.7	R
	30	3.7	R
9	2	3.7	R
	4	3.6	R
	7	3.8	R
	8	3.7	R
	9	3.8	R
	10	3.9	R
	13	4.1	R
	16	3.6	R
	17	3.6	R

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914—Continued.

β Lyrae

Mo.	Day	Est.	Obs.
9	18	3.6	R
	19	3.7	R
	23	3.7	R
	24	3.6	R

185243
R Lyrae

Mo.	Day	Est.	Obs.
9	10	4.8	R
	13	4.2	R
	14	4.1	R
	16	4.2	R
	18	4.1	R
	19	4.1	R
	23	4.2	R
	24	4.0	R

190108
R Aquilae

Mo.	Day	Est.	Obs.
8	25	10.1	L
9	1	9.6	Bu
	1	9.3	B
	5	9.4	Bl
	12	9.0	L
	12	9.2	Bu
	13	8.7	Bl
	14	8.6	M
	14	8.5	Ba
	15	8.5	B
	16	9.2	Bu
	19	7.9	Ba
	26	7.5	Ba
	27	8.6	Bu

190967
U Draconis

Mo.	Day	Est.	Obs.
9	19	13.1	Hu

190926
X Lyrae

Mo.	Day	Est.	Obs.
9	1	9.2	Bu
	2	8.8	Bl
	4	8.9	Ly
	11	8.8	Ly
	11	9.3	E
	11	9.0	C
	12	9.0	Bu
	13	9.0	C
	13	9.2	Bl
	13	9.4	Ma
	14	8.8	C
	14	9.0	M
	15	9.1	Pi
	15	8.6	C
	16	9.0	Bu
	18	8.9	Ly
	19	8.8	Ba
	26	9.0	Ba
	27	8.8	Bu
	28	9.1	Bl
	30	9.1	Ba

191019
R Sagittarii

Mo.	Day	Est.	Obs.
8	24	11.5	L
	25	11.5	L
9	14	12.3	Ba
	22	10.5	B

191033
RY Sagittarii

Mo.	Day	Est.	Obs.
9	8	7.4	C
	9	6.5	Bl
	9	7.2	C
	11	7.1	H
	11	7.0	C
	13	7.4	C
	14	7.5	C
	15	7.2	C
	19	7.2	R
	20	7.5	Bl
	23	7.1	H
	23	7.5	R

191350
TZ Cygni

Mo.	Day	Est.	Obs.
8	26	10.6	L
9	15	11.1	L

191637
U Lyrae

Mo.	Day	Est.	Obs.
9	8	11.7	Ba
	16	12.0	Ba
	26	11.8	Ba

193311
RT Aquilae

Mo.	Day	Est.	Obs.
8	25	8.7	L
9	1	9.2	Bu
	7	8.9	L
	8	8.4	Ba
	8	9.3	O
	12	9.4	Bu
	12	9.3	O
	13	8.5	Ba
	16	9.4	Bu
	16	9.5	O
	17	9.5	L
	18	9.5	O
	18	8.9	Ba
	22	9.8	O
	23	9.7	Ba
	26	9.8	O
	26	9.7	Ba
	27	9.6	Bu
	28	10.0	O
	30	9.8	Ba
10	1	10.2	O
	8	10.3	O

193449
R Cygni

Mo.	Day	Est.	Obs.
8	26	11.9	R
	26	11.5	L
9	1	11.5	Ly
	11	11.8	Ly

R Cygni

Mo.	Day	Est.	Obs.
9	13	10.8	Hu
	14	12.0	Ba
	15	11.6	L
	16	12.3	M
	18	12.0	E
	26	12.5	Ba
	26	12.0	M

193509
RV Aquilae

Mo.	Day	Est.	Obs.
9	9	12.3	Ba

193732
TT Cygni

Mo.	Day	Est.	Obs.
8	26	7.7	R
	26	7.0	L
9	1	8.0	Bu
	4	8.0	Ly
	5	8.2	Bl
	7	8.2	R
	8	7.8	Bu
	9	7.5	Ma
	11	8.1	Ly
	11	8.0	C
	13	7.0	Hu
	13	8.3	R
	13	8.0	C
	14	8.0	Bu
	14	7.9	C
	14	8.4	R
	15	8.3	R
	15	7.5	Ba
	15	7.8	C
	18	8.0	Ly
	18	8.3	R
	18	7.6	Ma
	19	8.3	R
	20	8.2	Bu
	22	7.6	B
	23	8.4	R
	23	6.7	Ba
	24	8.4	R
	26	7.0	Ba
	28	7.5	Bl
	28	7.5	B
	28	7.6	M

194048
RT Cygni

Mo.	Day	Est.	Obs.
8	26	9.1	L
	30	8.8	Ly
9	1	8.8	Bu
	1	8.5	Ly
	2	8.2	Ba
	5	8.4	Bl
	8	8.0	Ba
	8	8.4	Bu
	11	8.3	Ly
	12	7.9	Ba
	13	8.1	L

RT Cygni

Mo.	Day	Est.	Obs.
9	13	7.9	M
	13	8.0	Bl
	13	8.0	Hu
	13	8.5	R
	14	8.4	Bu
	14	8.0	R
	15	8.2	S
	15	7.9	R
	16	8.1	M
	17	8.3	Bl
	18	8.0	E
	18	8.1	R
	19	7.9	Ba
	19	8.1	R
	20	8.2	Ly
	20	8.2	Bu
	22	7.7	Ba
	23	8.2	R
	23	8.4	St
	24	8.2	R
	26	7.6	Ba
	27	8.3	M
	28	7.5	O
	28	8.2	Bl
	30	7.7	Ba
10	1	7.8	Le

194348
TU Cygni

Mo.	Day	Est.	Obs.
8	26	10.0	L
	30	10.4	Ly
9	1	10.0	Bu
	1	10.3	Ly
	2	9.7	Ba
	5	10.1	Bl
	8	9.7	Ba
	8	9.6	Bu
	11	10.1	Ly
	12	9.8	Ba
	13	10.0	Bl
	13	10.5	M
	13	9.4	R
	13	9.8	Hu
	13	10.6	L
	14	9.4	Bu
	14	9.2	R
	15	9.4	R
	16	10.6	M
	17	10.3	Bl
	18	10.4	E
	18	9.4	R
	19	10.1	Ba
	19	9.4	R
	20	9.9	Ly
	20	9.2	Bu
	22	10.2	Ba
	23	9.5	R
	24	9.4	R
	26	10.3	Ba
	27	10.8	M
	30	10.4	Ba

194604
X Aquilae

Mo.	Day	Est.	Obs.
8	25	11.0	L
9	9	11.6	Ba
	12	11.3	L
	15	11.9	B
	28	12.5	Ba

194632
χ Cygni

Mo.	Day	Est.	Obs.
8	26	9.7	L
9	1	9.0	Bu
	2	9.4	Bl
	5	8.8	Ly
	7	8.8	Bl
	8	8.6	O
	8	8.6	Bu
	9	8.8	J
	11	8.7	E
	11	8.7	C
	12	8.4	O
	13	7.7	Ba
	13	8.4	Ma
	13	8.7	M
	13	8.7	L
	13	8.2	Hu
	13	9.1	R
	13	9.0	C
	14	9.1	R
	14	8.2	Bu
	14	8.0	Ly
	14	8.6	Bl
	14	8.5	C
	15	8.7	R
	15	8.6	C
	16	8.6	E
	17	8.0	Bl
	18	8.3	R
	18	8.2	Ma
	19	8.5	J
	19	8.5	R
	19	7.8	Ba
	20	7.7	Ly
	20	8.0	Bl
	20	8.0	Bu
	22	8.1	O
	23	8.6	R
	24	8.6	R
	26	7.6	Ba
	27	7.5	O
	27	8.6	M
	28	8.5	M
	28	7.7	Bl
	30	8.4	M
10	8	7.0	O

194700
η Aquilae

Mo.	Day	Est.	Obs.
9	9	4.2	R
	10	4.6	R
	13	4.2	R
	14	4.1	R
	15	4.0	R

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914—Continued.

η Aquilae

Mo.	Day	Est.	Obs.
9	16	4.2	R
	18	4.5	R
	19	4.2	R
	23	4.4	R
	24	4.4	R

195116 S Sagittae

Mo.	Day	Est.	Obs.
8	26	5.8	R
	27	5.8	R
9	2	5.4	Bu
	7	6.0	R
	7	5.6	Mu
	8	5.4	O
	8	5.6	Mu
	8	5.6	R
	8	5.4	Bu
	9	5.7	Mu
	10	5.7	R
	10	5.8	Mu
	11	5.5	C
	12	6.0	Mu
	12	6.2	O
	13	5.9	Mu
	13	5.7	O
	13	5.6	R
	13	5.6	C
	14	5.7	Bu
	14	5.1	C
	14	5.9	Mu
	14	5.6	R
	15	5.3	C
	15	5.4	R
	16	5.6	R
	16	5.4	O
	17	5.4	O
	18	5.8	O
	19	6.2	Mu
	19	6.0	O
	19	5.6	R
	20	6.0	Bu
	20	6.1	O
	20	5.7	Mu
	21	5.5	Mu
	21	6.0	O
	22	5.7	O
	23	5.5	R
	24	5.6	Mu
	24	5.5	R
	26	5.7	O
	27	5.9	O
	28	6.0	O
10	1	5.4	O
	2	5.4	O
	5	5.7	O
	8	6.0	O

195849 Z Cygni

Mo.	Day	Est.	Obs.
8	29	9.5	L
9	2	9.2	Bu
	5	9.7	Ly
	8	9.0	Bu
	8	9.6	Sp
	11	10.0	Ly
	13	10.7	M
	13	10.3	V
	13	9.7	Sp
	14	10.3	Ba
	14	9.0	Bu
	15	9.6	Sp
	20	8.8	Bu
	20	10.5	Ly
	21	10.5	Sp
	22	10.5	B
	26	11.2	Ba
	27	11.1	M

200212 SY Aquilae

Mo.	Day	Est.	Obs.
9	15	12.5	B

200647 SV Cygni

Mo.	Day	Est.	Obs.
8	26	9.3	R
	26	9.3	L
9	1	9.0	Ly
	2	9.0	Bu
	5	9.4	Bl
	7	9.4	R
	8	9.3	R
	8	9.0	Bu
	9	9.4	R
	13	9.4	Bl
	13	9.3	R
	13	9.2	Ma
	13	8.0	Hu
	14	9.0	Bu
	14	9.2	C
	14	9.3	R
	15	8.0	Ba
	15	9.3	L
	15	9.4	R
	15	9.4	M
	16	9.3	Ly
	18	9.4	R
	19	9.2	Ma
	19	9.3	R
	20	9.3	Bl
	20	9.0	Ly
	20	8.8	Bu
	23	9.4	R
	23	8.4	Ba
	24	9.5	R
	26	8.2	Ba
	27	8.4	M
	28	9.5	Bl
	30	8.2	B

200715a S Aquilae

Mo.	Day	Est.	Obs.
9	2	10.4	Bu
	4	9.5	B
	8	10.6	Bu
	14	9.6	M
	22	9.6	Ba
	22	9.6	B
	26	9.6	Ba
	27	9.8	M
	29	9.4	B

200715b RW Aquilae

Mo.	Day	Est.	Obs.
9	2	8.8	Bu
	4	9.3	B
	8	9.0	Bu
	10	9.1	Ba
	14	9.2	M
	14	9.0	Bu
	20	8.6	Bu
	22	9.0	Ba
	22	9.3	B
	26	9.0	Ba
	27	9.0	M
	29	9.2	B

200812 RU Aquilae

Mo.	Day	Est.	Obs.
9	15	13.5	B

200906 Z Aquilae

Mo.	Day	Est.	Obs.
9	11	12.9	B

200916 R Sagittae

Mo.	Day	Est.	Obs.
8	26	8.6	R
9	7	9.0	R
	8	9.1	R
	9	9.1	R
	13	9.0	R
	14	9.1	R
	15	9.1	R
	18	9.0	R
	22	8.9	Ba
	22	9.1	B
	23	9.4	R
	26	8.8	Ba
	29	9.0	B

200938 RS Cygni

Mo.	Day	Est.	Obs.
8	26	8.6	R
	26	8.6	L
9	1	8.3	Ly
	2	8.2	Bu
	8	8.4	Bu
	9	8.8	R
	13	8.8	R
	13	7.4	Ma
	14	8.2	Bu

RS Cygni

Mo.	Day	Est.	Obs.
9	14	8.7	R
	15	7.1	Ba
	15	7.5	L
	15	8.7	R
	16	7.5	Ly
	18	8.7	R
	19	7.5	Ma
	19	8.8	R
	20	8.6	Bu
	22	6.7	Ba
	23	8.9	R
	26	7.1	Ba
	30	7.0	Ba

201008 R Delphini

Mo.	Day	Est.	Obs.
9	2	8.6	Bu
	5	8.4	Bl
	8	8.4	Bu
	8	8.4	O
	9	8.3	Ma
	9	8.1	J
	10	8.2	Ba
	12	8.3	O
	13	8.4	M
	13	8.4	O
	14	8.2	Bu
	15	8.3	Pi
	16	8.2	Ba
	16	8.3	Ma
	17	8.2	B
	19	8.5	O
	19	8.5	R
	20	8.0	Bu
	21	8.3	Bl
	22	8.6	O
	23	8.6	R
	26	8.5	Ba
	26	8.8	O
	27	8.6	M
	28	8.7	O
	28	8.5	B
10	8	9.2	O

201139 RT Sagittarii

Mo.	Day	Est.	Obs.
9	9	7.5	Bl
	9	7.8	C
	11	7.6	C
	13	8.1	C
	14	8.1	C
	15	8.0	C
	21	8.3	Bl

201121 RT Capricorni

Mo.	Day	Est.	Obs.
8	24	7.3	L
9	5	7.7	Ly
	12	7.5	Ly
	14	6.5	Ba
	15	6.6	L

201647 U Cygni

Mo.	Day	Est.	Obs.
8	26	6.9	R
	26	7.8	L
9	1	7.5	Ly
	2	7.2	Bu
	5	7.0	Bl
	7	7.2	R
	8	7.3	R
	8	7.0	Bu
	9	7.4	R
	12	7.3	Ly
	13	7.5	R
	13	6.5	Bl
	14	7.4	C
	14	7.5	R
	14	7.0	Bu
	15	7.3	L
	15	7.4	Ba
	15	6.5	S
	15	6.6	M
	15	7.3	R
	16	7.1	Ly
	18	7.6	R
	19	7.8	R
	20	7.2	Ly
	20	7.0	Bl
	20	6.8	Bu
	23	7.7	R
	23	7.2	Ba
	24	7.6	R
	26	6.5	Ba
	27	7.0	M
	28	6.5	Bl
	30	6.3	Ba

202539 RW Cygni

Mo.	Day	Est.	Obs.
8	29	8.6	Ly
9	2	8.7	Bu
	3	8.5	Ly
	5	9.0	Bl
	8	8.5	Bu
	9	8.4	Ma
	13	8.6	Bl
	14	8.5	Ba
	14	8.5	Ma
	14	8.4	M
	15	7.8	Ba
	16	8.5	Ly
	19	8.6	B
	20	8.4	Bu
	20	8.5	M
	26	8.0	Ba
	27	8.9	M
	28	8.8	Bl
	30	9.0	M
	30	8.0	Ba

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

202817
Z Delphini

Mo.	Day	Est.	Obs.
9	8	11.3	Ba
	13	10.8	V
	16	10.3	Ba
	26	9.3	Ba

202938
SZ Cygni

Mo.	Day	Est.	Obs.
8	26	9.4	R
	27	9.2	R
9	1	9.7	Ly
	2	9.4	Ba
	2	10.0	Bl
	2	9.5	Bu
	2	9.8	Le
	4	9.6	Bl
	5	9.7	Bl
	6	9.5	Bl
	7	9.7	R
	7	9.6	Bl
	8	9 9	Bu
	8	8.8	Le
	8	9.3	R
	8	9.5	Bl
	8	9.0	E
	8	8.8	Ba
	9	9.4	Bl
	9	9.1	R
	9	8.8	Le
	11	8.9	Le
	13	9.6	Bl
	13	9.6	R
	13	8.6	Hu
	14	9.4	Bu
	14	9.5	Bl
	14	9.7	R
	14	9.0	M
	15	9.2	Ba
	15	9.7	R
	15	9.6	Bl
	17	10.0	Bl
	18	9.8	E
	18	9.6	R
	18	9.8	Le
	19	9.4	Ba
	19	10.1	Bl
	19	9.8	R
	20	10.0	Bl
	20	9.5	M
	20	10.0	Bu
	21	9.7	Bl
	22	9.5	Ba
	23	9.1	Ba
	23	9.3	R
	24	9.4	R
	26	8.8	Ba
	26	9.3	Bl
	27	9.3	L
	28	9.3	Bl
	28	8.6	Ba
	30	9.1	Ba
	30	9.5	Le

SZ Cygni

Mo.	Day	Est.	Obs.
10	1	9.6	Le
	2	9.7	Le
	3	9.7	Le
	6	9.4	Le

202954
ST Cygni

Mo.	Day	Est.	Obs.
9	13	10.9	Hu
	15	11.7	Ba
	21	12.3	B
	28	11.8	Ba

203816
S Delphini

Mo.	Day	Est.	Obs.
9	21	10.5	Y

203847
V Cygni

Mo.	Day	Est.	Obs.
9	2	8.6	Bu
	8	8.4	Bu
	14	8.4	Bu
	15	9.3	M
	19	8.6	Ba
	20	9.4	M
	20	8.2	Bu
	21	8.8	B
	27	9.6	M
	28	8.7	B
	28	8.8	Ba

204016
T Delphini

Mo.	Day	Est.	Obs.
9	21	9.3	Y

204318
V Delphini

Mo.	Day	Est.	Obs.
9	10	12.6	Ba
	16	12.6	Ba

204405
T Aquarii

Mo.	Day	Est.	Obs.
9	8	8.2	Ba
	9	8.2	Bl
	9	8.2	J
	11	8.5	C
	11	8.1	Ly
	13	8.5	C
	14	8.9	M
	14	8.9	C
	14	7.5	Bu
	15	8.6	C
	17	8.5	B
	19	8.8	Ba
	19	8.7	Bl
	19	8.5	Hy
	20	8.4	Ly
	26	8.8	Ba
	28	8.9	B

205017
X Delphini

Mo.	Day	Est.	Obs.
9	10	12.1	Ba
	16	11.5	Ba

205923
R Vulpeculae

Mo.	Day	Est.	Obs.
9	10	12.3	Ba
	14	11.3	Hu
	16	11.2	M
	19	11.2	J
	25	10.4	M
	26	10.1	Ba

210116
RS Capricorni

Mo.	Day	Est.	Obs.
9	5	8.3	Bl
	8	8.2	C
	9	8.1	C
	11	8.2	C
	11	8.5	Ly
	13	8.2	C
	14	8.0	Ba
	14	8.0	C
	15	8.2	C
	17	8.1	Bl
	22	8.4	Ly
	23	8.1	Ba
	26	8.1	Ba

212030
S Microscopii

Mo.	Day	Est.	Obs.
9	9	10.5	C
	11	10.5	C
	13	10.3	C
	14	10.3	C
	15	10.7	C

210129
TW Cygni

Mo.	Day	Est.	Obs.
9	11	11.0	E
	12	10.5	Ba
	13	10.4	V
	24	10.5	V
	26	10.5	Ba

210868
T Cephei

Mo.	Day	Est.	Obs.
8	23	6.9	L
9	2	7.2	Bu
	2	7.1	Ma
	3	7.3	L
	5	7.1	Ly
	5	7.2	Bl
	8	7.0	Ma
	8	7.0	O
	8	7.0	Bu
	10	7.9	Bk
	12	7.0	O
	13	7.0	Ma
	13	7.3	Ly
	14	6.8	Bu

T Cephei

Mo.	Day	Est.	Obs.
9	14	6.6	Ba
	14	7.8	M
	14	6.9	Bg
	15	6.0	Bl
	16	7.2	Ma
	17	6.7	L
	17	7.8	Bk
	19	7.4	S
	20	6.6	Bu
	20	7.1	Ly
	22	6.7	Ba
	24	7.3	Ma
	26	6.6	Ba
	30	6.6	Ba
10	1	6.7	O
	9	6.5	O

211614
X Pegasi

Mo.	Day	Est.	Obs.
9	12	12.0	Ba
	16	12.1	Ba
	26	13.0	Ba

211615
T Capricorni

Mo.	Day	Est.	Obs.
8	24	9.9	L
9	15	9.7	L

213044
W Cygni

Mo.	Day	Est.	Obs.
8	23	5.6	L
	26	6.7	R
	27	6.5	R
9	2	6.0	Bu
	3	5.8	L
	7	6.5	R
	8	6.0	Bu
	8	6.7	R
	9	6.7	R
	10	6.6	R
	11	6.2	C
	13	5.9	L
	13	6.1	C
	13	6.7	R
	14	6.0	Bu
	14	6.6	R
	14	6.2	C
	15	6.1	L
	15	6.3	C
	15	6.8	R
	16	6.5	R
	18	6.6	R
	19	6.5	R
	20	6.0	Bu
	23	6.7	R
	24	6.5	R
	29	6.8	St

213678
S Cephei

Mo.	Day	Est.	Obs.
9	14	9.4	Ba
	14	10.0	M
	15	9.5	Hu
	15	10.3	S
	28	9.0	Ba

213753
RU Cygni

Mo.	Day	Est.	Obs.
9	2	8.4	Bu
	4	8.4	Ly
	7	8.5	Bl
	8	8.6	Bu
	12	8.4	Ly
	13	8.5	Sp
	14	8.8	Bu
	18	8.6	E
	20	8.6	Bu
	20	8.3	Ly
	26	8.5	Ba

213843
SS Cygni

Mo.	Day	Est.	Obs.
8	23	8.2	L
	24	8.2	L
	25	8.3	L
	26	8.7	L
	26	8.9	R
	27	9.2	R
	28	9.1	L
	30	10.3	Le
9	1	11.5	J
	1	10.9	Ly
	2	11.5	Ba
	2	11.2	Bu
	2	11.3	Le
	7	11.6	Ba
	8	11.4	Le
	8	11.5	Bu
	8	11.6	Ba
	8	11.2	Ly
	8	11.6	Sp
	8	11.7	E
	8	12.0	Bl
	9	12.0	Bl
	9	11.6	Ba
	9	11.4	Le
	10	11.6	Ba
	11	11.7	E
	11	11.2	Bk
	12	11.6	Ba
	12	11.6	J
	13	11.7	L
	13	11.6	Ba
	13	12.0	Bl
	13	12.0	M
	13	11.6	J
	13	11.8	Sp
	13	11.3	Hu
	14	11.0	C
	14	12.0	Bl

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914.—Continued.

SS Cygni

Mo.	Day	Est.	Obs
9	14	11.7	M
	14	11.5	Hu
	14	11.6	Bk
	14	11.5	R
	14	11.7	Ba
	15	11.9	L
	15	12.0	Bl
	15	11.7	J
	15	11.9	Sp
	15	11.6	B
	15	11.6	M
	15	11.6	Ba
	16	11.7	Bk
	16	11.6	Ba
	16	11.7	E
	16	11.6	J
	16	11.6	M
	16	11.4	Ly
10	17	11.6	J
	17	11.6	B
	17	12.0	Bl
	18	11.5	Le
	18	11.5	Ba
	18	11.5	J
	18	11.3	R
	18	11.3	E
	18	11.4	B
	19	11.6	Ba
	19	11.4	B
	19	11.3	J
	19	11.3	E
	19	12.0	Bl
	20	11.5	J
9	20	11.7	Sp
	20	11.6	Ly
	21	11.8	Bl
	21	11.5	Sp
	21	11.7	E
	21	11.3	B
	21	11.3	J
	22	11.6	Ba
	22	11.1	J
	22	11.4	B
	23	10.9	Ba
	23	10.7	R
	23	10.6	B
	24	11.0	M
	24	10.4	B
	24	10.0	R
	25	10.5	J
	25	10.5	M
	26	10.5	Bl
	26	9.8	O
	26	10.1	J
	26	10.2	B
	26	10.2	Ba
	26	10.0	Pi
	26	10.0	M
	27	9.9	B

SS Cygni

Mo.	Day	Est.	Obs.
9	27	9.7	J
	27	9.5	O
	27	9.8	M
	28	9.7	B
	28	9.7	J
	28	9.6	M
	28	9.5	Bl
	28	9.6	Ba
	29	9.6	Pi
	29	9.6	B
	29	9.4	J
	30	9.4	M
	30	9.1	M
	30	9.4	Pi
	30	9.2	J
	30	9.2	Ba
	30	9.1	Le
10	1	8.7	M
	1	8.5	O
	1	9.0	Le
	2	8.5	O
	2	8.7	Le
	3	8.5	O
	3	8.8	Le
	5	9.5	O
	6	10.0	Le

213937
RV Cygni

Mo.	Day	Est.	Obs.
8	26	8.0	R
	26	6.8	L
	30	6.4	Le
9	1	7.5	Ly
	2	6.4	Le
	2	8.0	Bu
	3	7.0	Ma
	7	8.0	Bl
	8	6.4	Le
	8	6.9	Ma
	8	8.2	Bu
	9	6.3	Le
	9	8.1	R
	12	7.3	Ly
	13	8.5	R
	13	7.2	Ma
	14	8.0	R
	14	7.2	Hu
	14	8.2	Bu
	14	8.2	M
	14	6.8	Ba
	14	7.8	C
	15	6.6	L
	15	7.9	R
	15	7.0	Bl
	18	8.0	R
	18	7.9	E
	18	6.4	Le
	19	8.1	R
	19	7.4	Ma
	20	7.1	Ly

RV Cygni

Mo.	Day	Est.	Obs.
9	20	8.3	M
	20	8.4	Bu
	23	6.7	Ba
	23	8.0	R
	24	7.3	Ma
	26	6.6	Ba
	27	8.0	M
	30	6.5	Le
10	1	6.5	Le
	2	6.5	Le
	3	6.4	Le
	6	6.4	Le

214024
RR Pegasi

Mo.	Day	Est.	Obs.
9	12	13.4	E
	9	13.5	B

215605
V Pegasi

Mo.	Day	Est.	Obs.
9	12	12.2	Ba
	12	12.6	E
	16	12.3	Ba

215934
RT Pegasi

Mo.	Day	Est.	Obs.
9	16	11.3	Ba

220613
Y Pegasi

Mo.	Day	Est.	Obs.
9	9	9.7	Bl
	18	9.3	O
	19	9.2	O
	27	9.0	O

220714
RS Pegasi

Mo.	Day	Est.	Obs.
9	19	11.4	O
	27	10.7	O

222557
δ Cephei

Mo.	Day	Est.	Obs.
8	26	3.9	R
	27	3.8	R
	30	3.7	R
9	7	3.2	R
	8	3.7	R
	9	3.8	R
	10	3.8	R
	13	3.5	R
	14	3.9	R
	15	3.8	R
	16	3.8	R
	18	3.7	R
	19	3.9	R
	23	4.0	R

225914
RW Pegasi

Mo.	Day	Est.	Obs.
9	28	12.5	Ba

230110
R Pegasi

Mo.	Day	Est.	Obs.
9	2	9.8	Bu
	5	10.8	Ly
	8	9.6	Bu
	8	10.8	Ba
	12	10.6	Pi
	12	10.7	O
	12	10.7	Ly
	14	9.6	Bu
	14	10.6	Hu
	15	10.7	Pi
	16	10.2	M
	16	10.5	Ba
	18	10.9	E
10	19	10.1	O
	20	9.6	Bu
	20	10.1	M
	21	10.1	Y
	22	10.1	O
	23	10.3	Ba
	26	10.1	O
	26	10.2	Pi
	28	9.7	Ba
10	8	9.6	O

230759
V Cassiop.

Mo.	Day	Est.	Obs.
9	2	8.7	Ba
	4	8.9	B
	5	9.3	Ly
	7	9.2	Ba
	8	9.4	O
	12	9.9	Ly
	14	10.0	Ly
	15	10.0	Hu
	15	9.9	Bl
	16	9.6	Ba
	17	10.0	O
	18	10.3	E
	19	9.6	B
	21	9.8	Bl
	23	10.1	Ba
	28	9.8	M
	28	10.5	Ba

231425
W Pegasi

Mo.	Day	Est.	Obs.
9	1	9.8	Ly
	8	9.9	Ly
	9	10.5	Bl
	12	10.0	Ba
	13	10.1	V
	14	10.0	Hu
	18	10.4	E
	19	10.5	O
	21	10.7	Bl
	24	10.3	V
	28	10.2	Ba

231508
S Pegasi

Mo.	Day	Est.	Obs.
9	12	9.0	Ba
	12	9.4	O
	16	9.0	B
	16	9.6	O
	18	9.6	E
	19	9.5	O
	21	9.5	Bl
	22	9.5	O
	26	9.3	B
	26	10.1	O
	28	10.2	O
	28	9.4	Ba
10	8	10.4	O

233335
ST Androm.

Mo.	Day	Est.	Obs.
9	2	9.4	Bu
	2	8.9	Ba
	5	9.2	Bl
	5	9.2	Ly
	8	9.2	Bu
	8	8.9	Ba
	12	8.8	Ba
	12	9.2	Ly
	12	9.0	O
	13	9.1	O
	14	9.0	Bu
	14	8.8	Hu
	15	9.1	Bl
	18	9.1	O
	18	9.1	E
	19	9.0	S
	19	8.9	Ba
	20	8.6	Bu
	21	8.7	B
	21	9.5	Bl
	22	9.0	O
	22	8.9	Ba
	26	9.2	O
	28	8.9	Ba
	30	9.2	Pi
10	1	9.2	O
	9	9.2	O

233815
R Aquarii

Mo.	Day	Est.	Obs.
9	2	7.2	Bu
	8	6.5	Ba
	8	7.4	Bu
	12	7.2	Pi
	14	7.4	Bu
	19	7.2	Bl
	20	7.6	Bu
	28	7.2	Ba

235182
V Cephei

Mo.	Day	Est.	Obs.
9	11	6.7	C
	13	6.8	C
	14	6.7	C
	15	6.9	C

VARIABLE STAR OBSERVATIONS Sept.-Oct., 1914—Continued.

235350 R Cassiop.				R Cassiop.				235525 Z Pegasi				235939 SV Androm.				SV Androm.		
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
9	2	7.6	Bu		15	6.7	Hu	9	12	12.7	Ba	9	12	9.6	Ba	19	8.7	Ba
	8	7.4	Bu		20	7.2	Bu		16	12.7	Ba		14	9.1	Hu	21	8.2	B
	12	5.0	Ba		21	5.8	B		17	12.6	E		18	8.6	E	26	9.0	O
	14	7.4	Bu	10	1	5.7	O		28	12.4	Ba					28	8.0	Ba

number of observations made during the year is not higher as compared with the record of last year is largely due to the energetic campaign we are waging on the variables on the neglected list, which are for the most part faint and yield only negative results to observers with small telescopes. As only positive observations figure in the record, the amount of work done by the Association is by no means fully indicated.

As an indication of what has been accomplished in the way of chart distribution, which has contributed no small part to our progress, the Secretary's records show that he has distributed to members of the Association over 1200 blue prints. Complete sets of our charts have been ordered by observers in England and Australia.

In efficiency and value of service we are now far exceeding any work heretofore done, a most encouraging and stimulating state of affairs for all concerned.

We are grateful and ever mindful in our work of the guiding hand of Professor E. C. Pickering, Director of the Harvard College Observatory, and the many courtesies extended by that institution.

Thanks are also due Professor H. C. Wilson, Editor of POPULAR ASTRONOMY, for his continuing interest in our work, and the publication of the reports which are so important to the welfare of our Association.

In conclusion, the Secretary heartily thanks each and every member for the interest taken in the work, for the willingness on the part of each one to assist in every way possible, for the splendid esprit de corps that is such a prominent and commendable feature of the Association, and which renders it a pleasure to serve the cause to the best of one's ability. The following members contributed to the monthly report: Messrs. Baldwin, Bancroft, Bolfing, Bouton, Brunswick, Burbeck, Craig, Eaton, Hay, Hunter, Huntington, Jacobs, Leonard, Lindsley, Mach, McAteer, Mundt, Olcott, Pickering, Richter, Spinney, Stepka, Vrooman, Miss Swartz, Miss Young.

WILLIAM TYLER OLCOTT,
Corresponding Secretary.

Norwich, Ct. Oct. 10, 1914.

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS FOR THE YEAR ENDING OCT. 10, 1914.

RECORD OF OBSERVATIONS

1913—1914	Baldwin (Bl)	Bancroft (Ba)	Barbour (Bb)	Bolfing (Bg)	Bouton (B)	Brunswick (Bk)	Bruseth (Br)	Burbeck (Bu)	Craig (C)	Eaton (E)	Gray (G)	Hay (Hy)	Hunter (Hu)	Huntington (H)	Jacobs (J)	Lacchini (L)	Leonard (Le)	Lindsley (Ly)	Mach (Ma)	McAteer (M)	Mundt (Mu)	Olcott (O)	Pickering (Pi)	Putnam (P)	Richter (R)	Spinney (Sp)	Stepka (St)	Miss Swartz (S)	Vrooman (V)	Yamasaki (Ya)	Miss Young (Y)	Additional Ob.	Total Number of Observations	No. of Observers	No. of Var. Obs'd.
Nov.		226			51		74	52	75		218		40	52	32	80	50		42	60		134					8	17				1239	19	130
Dec.		184			31		43	59	104	1	161		29	17	7	66	32		31	40		63				10	8	21				957	19	137
Jan.		260			37		31	40	58		91		13	7	8	195	7		13	51		82		26		7	11	11				948	18	135
Feb.		213			26			23	3	1	75		21	7	5	96	10			39		41		30			9	11	43	24		686	20	149
Mar.		236			34		37	89			110		13		1	106	16			15		28		12	12	10	14	24	91	31		879	19	145
Apr.		235	43		39		36	82	15	1	172		21	2	3	40				27		64		9	26	11	8	15		34		883	20	128
May		255	43		46			119		6	108		28	4	3	237		49	24	97		66		27	48		15	9		31		1215	19	143
June		270	50		18			57	19	12	79		17	19	2	236	40	96	36	118		83		30	35	10	15	21		33		1296	22	146
July	30	199			35		34	24		32	152		33	63	3	227	59	110	35	53		87		17	61	31	6	15	18			1328	23	131
Aug.	77	130	18		32		19	171	2	45	67		22	23	30	124	39	279	26	126		63		19	128	12	4		19			1477	24	144
Sept.	182	112		5	34		17		1	75			23	15	12	310	34	181	43	89	12	41	40	3	236	23			23			1331	22	137
Oct.	166	**437**		7	102	25		183	103	33		4	35	41	51	128	42	144	50	128	23	148	26		318	21	7	14	18		13		2257	26	176
Total	455	**2757**	154	12	485	25	291	899	380	206	1233	4	295	250	157	1665	329	859	300	843	35	900	66	173	864	87	65	117	207	134	166	95	**14506**		

ANNUAL RECORD OF THE ASSOCIATION.

Year	Number of Observers	No. of stars Observed	Number of Observations	Total
1912	19	175	6180	
1913	20	200	12914	
1914	28	255	14506	33600

Practical Work for Observers Without Telescopic Equipment.

Mr. Leon Campbell in his article entitled "A Systematic Search For Bright Novæ" in the October issue of POPULAR ASTRONOMY, outlines an interesting line of observational work that should appeal to all observers interested in accomplishing something of a practical nature in the realm of astrophysical research. The work should be of special interest to all members of the American Association of Variable Star Observers; however, as the search for novæ can be conducted with the aid of a field or opera glass, an opportunity for making practical observations is open to all.

The writer will be glad to hear from those interested in this research work, and calls for volunteers to cover the various zones referred to in Mr. Campbell's article. Applicants may make their own choice of these zones, but if anticipated in their choice and there should be an insufficient number of observers to cover the area to be observed, they will be requested to make another selection. In this way each observer can choose for himself the region best adapted to his view of the heavens. The first five zones have already been selected by observers.

It will take but a short time to become familiar with the region selected, and subsequently the survey for novæ can be quickly made and interfere in only a slight degree with the work of the variable star observing.

The Novæ Section of the S. P. A., under the able direction of Mr. Nels Bruseth, is already engaged in this interesting and valuable work. By increasing the numbers engaged in this systematic search, the chance for discovery will be correspondingly improved.

Mr. Campbell's suggestion should meet with a hearty response from all who desire to make observations that are worth while, and who wish to promote the cause of practical astronomy.

WILLIAM TYLER OLCOTT,
Norwich, Conn.

GENERAL NOTES.

Mr. A. F. Beal has been appointed Fellow in Astronomy at the Allegheny Observatory. He was formerly in charge of the Magnetic Observatory at Tucsan, Arizona.

Dr. R. Trumpler, astronomer for the Geodetic Commission of Switzerland, has been appointed Assistant at the Allegheny Observatory, but has thus far been prevented from beginning his duties at that institution on account of the European war, Dr. Trumpler being an officer in the Swiss army.

Dr. Karl Schwarzschild, Director of the Potsdam Observatory is reported to have joined the army.

Visitors at Greenwich.—Among the visitors to the Royal Observatory, Greenwich, during September have been Prof. and Mrs. W. W. Campbell, Prof. H. D. Curtis and party of the Lick Observatory, and Prof. C. D. Perrine and Mr. Mulvey of the Cordoba Observatory. Both parties are returning from eclipse expeditions in Russia, neither of which, unfortunately, met with success, owing to cloudy skies The Lick Observatory party was stationed near Kiev, practically on the central line, while the Cordoba observers were near Theodosia with Prof. and Mrs. Newall. (*The Observatory*, October 1914.)

The Solar Eclipse of August 21-22, 1914.—The members of the English and American eclipse expeditions to Russia have returned to their homes in safety. They report successful observations at Minsk, Riga and the Swedish coast, but total failure on account of clouds at the stations near Kiev. We hope to have an account of the Lick Observatory expedition, and perhaps of others, by Dr. H. D. Curtis in the next number of POPULAR ASTRONOMY.

Astronomical Announcements.—Owing to the war in Europe the usual interchange of astronomical announcements between this Observatory and the Astronomische Centralstelle at Kiel, Germany, is necessarily suspended. It is, therefore, requested that all cable messages relating to astronomical discoveries be sent to this Observatory, addressed "Observatory, Boston." Announcements received in this way will be distributed at once throughout the United States and to foreign countries as far as practicable. The system and code described in a pamphlet published by this Observatory in 1906, entitled "Telegraphic Cipher Code," has been in use for several years for all messages sent in the United States and between Kiel and Cambridge. It is requested that messages be sent in this code.

EDWARD C. PICKERING,
Director.

Harvard College Observatory, Bulletin 563.
Cambridge, Mass., U. S. A., September 23, 1914.

Flower Observatory.—Professor Eric Doolittle writes in response to our inquiry that the results of measures of more than 3000 double stars are now ready for the printer, and that the work on the extension of Burham's General Catalogue goes steadily on.

The reductions for the determination of the longitude of the observatory from the Arlington wireless signals have been finished and the work seems to be highly satisfactory, the greatest range from night to night being 0.175 seconds. Every possible precaution was taken, the inequality of the pivots, the level value, etc., being determined anew. The following are the final corrected results for seven nights:

Date		Longitude from Washington	
1913	November 20	-7^m 8^s.684	
	22	8 .735	
	December 11	8 .787	
	13	8 .833	
	15	8 .657	
	18	8 .754	
	19	8 .750	
		Mean -7^m 8^s.7427	Probable error $\pm 0^s.015$

Mimas and Enceladus.—The Lowell Observatory Bulletin, No. 64, gives as the conclusion from observations by Professor Lowell and Mr. E. C. Slipher upon these two satellites of Saturn that there is definite variation in the light of these bodies which recurs regularly with regard to the position of the bodies relative to the planet. This indicates that they always turn the same face to the primary just as the moon does to the earth. This, moreover, is the general rule for all satellites concerning which sufficient evidence has been secured.